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Sea Frontiers

Bulletin of the INTERNATIONAL OCEANOGRAPHIC FOUNDATION

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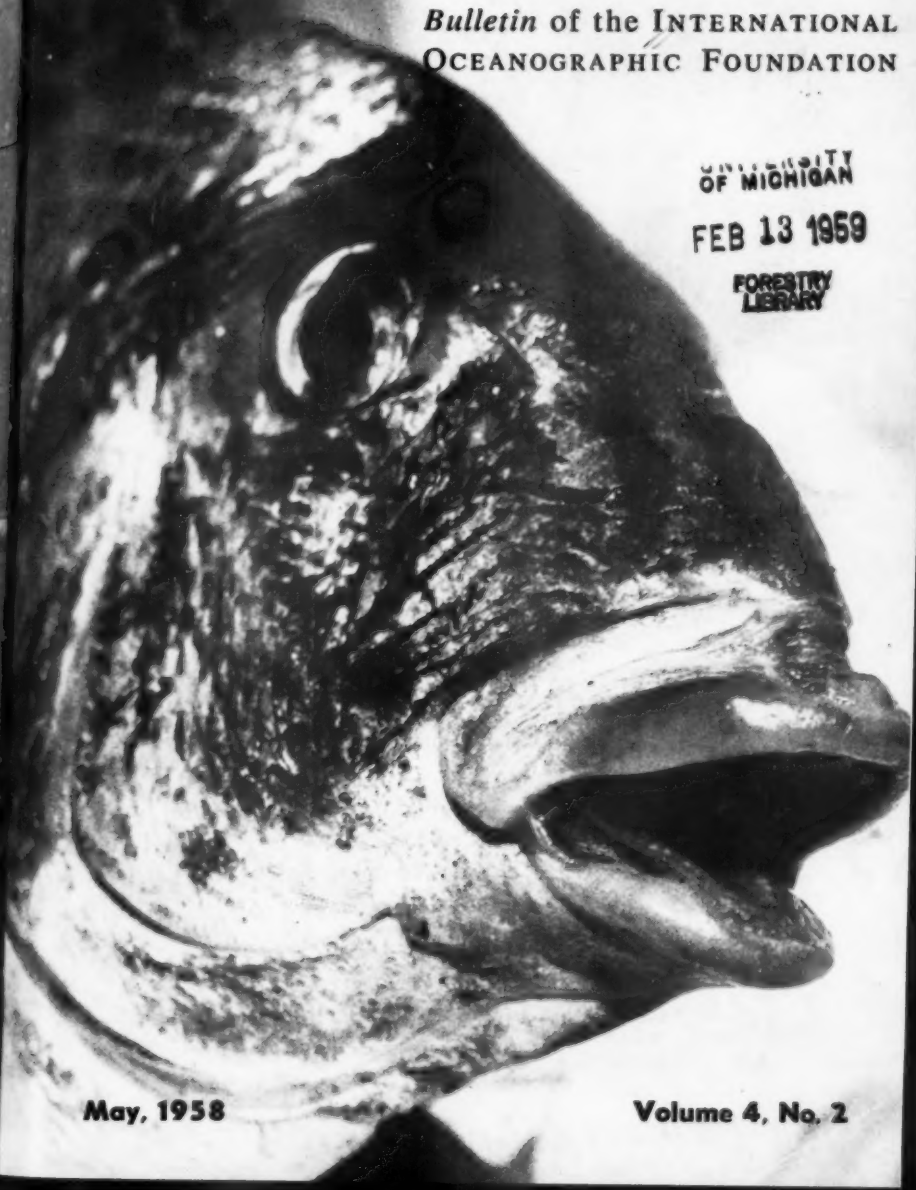

May, 1958 Volume 4, No. 2

SHROPSHIRE SHEEP DOGS *taking a bath? No, just a school of porpoises breaking water off the bow of a ship near Hawaii. Porpoises are friendly creatures. Their ability to indulge in play and to learn tricks indicates a high level of intelligence. (John E. Randall)*

FRONT COVER. "Now Hear This!" *An open-mouthed porgy, viewed closeup, seems to be sounding off in traditional Navy fashion. He might expound further upon the merits of the porgy family—an excellent food fish, always commanding good prices in the market and, where it is caught on hook and line, also providing some sport. (Bernard Gordon)*

BACK COVER. Everything rigged but the captain's pants. *With two borrowed dingy sails, one used as a spinnaker and the other as a sprit topsail, the work boat "Kleerer Naomi" speeds to victory in the Fifth Annual Out Island Regatta, off George Town, Exuma, April, 1958. Part of the Exumas chain has been proposed as a new land-sea park. See page 72. (Bahamas News Bureau)*

SEA FRONTIERS

Bulletin of the INTERNATIONAL OCEANOGRAPHIC FOUNDATION

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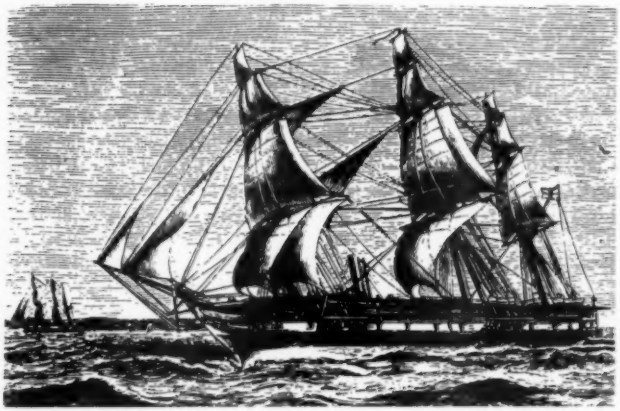
Table of Contents



VOLUME 4, NO. 2 MAY, 1958

PAGE

Stepping Stone to World Peace? ..... Editorial 66

Bahamian Land-and-Sea Park . John Randall and Carleton Ray 72

Of Ships and Herring Runs ..... Robert Ellis 81

A Shocking Way to Fish! ..... C. P. Idyll 88

Pathfinder of the Seas ..... J. L. McHugh 101

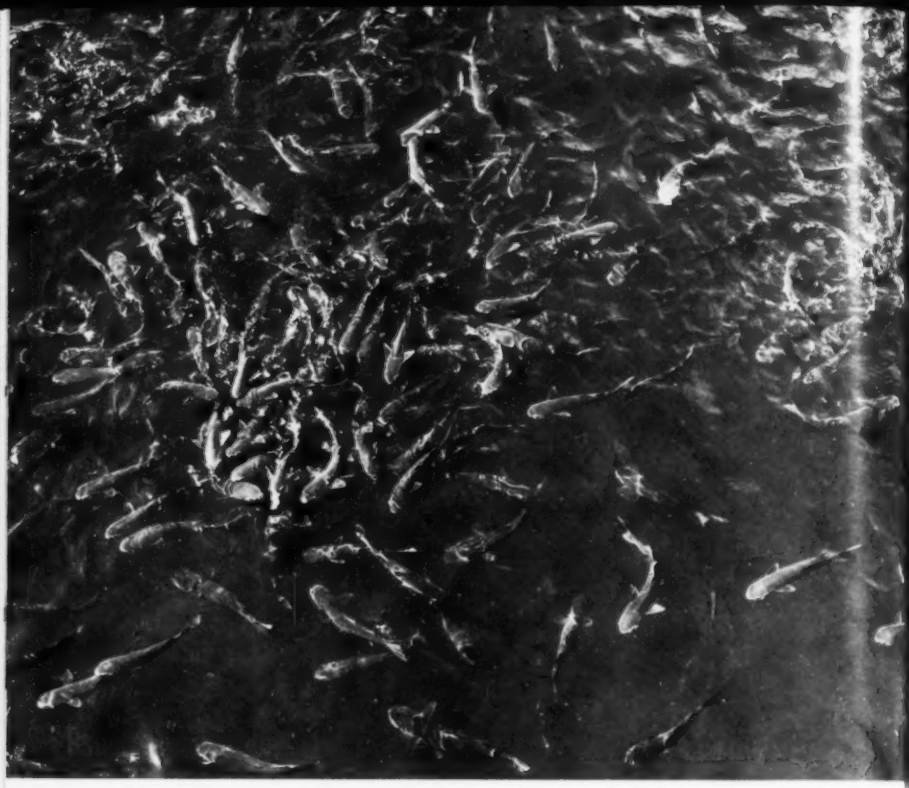
New Research Stimulus ..... F. G. Walton Smith 113

Tracking Hurricanes at Sea ..... H. V. Senn 116

Longest Coastline Evaporating? 122

Book Reviews 124

About the Authors 126



IF ALL FISHES WERE LIKE THESE MULLET *and lived in shallow coastal waters, there would be no international problems of jurisdiction and no quarrels over the right to fish. The United States, for instance, have undisputed control over the mullet fisheries of Florida, which lie within the recognized three-mile limit. Unfortunately, many offshore fisheries, such as the Pacific tuna-fishery, are carried out in waters sufficiently far from shore to be considered international or national, according to the nationality of the fishermen. (Miami Marine Laboratory)*

Stepping Stone To World Peace?

CHAOS and consternation prevail when law breaks down. Since World War II there have been growing misgivings among seafaring nations, particularly those which have big fishing fleets, as a result of the breakdown of customs which were "unwritten law" relating to the width of the territorial sea.

This vital question, and the related rights and responsibilities of nations in their use of the sea and its resources, were topics of grave debate at the International Law Commission Conference on the Law of the Sea, held this spring in Geneva, Switzerland. Marine biologists and legal experts from 89 countries took part, and, while the meeting again deadlocked over a definition of territorial

waters to replace the classic three-mile limit, five new treaties on other maritime matters were approved, subject to ratification by the home governments concerned.

Origin of the "Three Mile Limit"

Since the 18th century, the principal maritime nations have regarded three miles off the coast as the width of the territorial sea. These countries include the United States, Great Britain, the nations of the British Commonwealth, Japan, France, Belgium, Germany and the Netherlands. The basis of the three-mile limit of territorial waters was the supposed distance that a land-based cannon could fire a shell in the late 1700's.

The three-mile limit has never been universally accepted, however, and various other widths of the territorial sea have been claimed. For example, the Scandinavian countries insist on keeping control over four miles of coastal waters; Greece, Spain, Italy and Egypt have claimed six miles; our neighbor Mexico regards her territory to extend out nine miles to sea (as U. S. shrimp fishermen well know); Russia and other states claim twelve miles.

Norway Versus England

It is apparent then, that no clear-cut code of international law defines territorial waters. The need for formal rules on this matter is increasingly apparent.

In 1930 the subject was exhaustively discussed at the Conference on the Codification of International Law at The Hague. No agreement was reached and the problem became all the more pressing. In 1949, the International Law Commission of the United Nations decided that this was an aspect of international law requiring *first* consideration.

A number of international disputes soon gave even greater urgency to the problem. In 1951 the International Court of Justice decided in favor of Norway, and against England, allowing the former to declare as her sovereign territory waters in bays and inlets which are enclosed by lines between points of land 50 miles or less apart. This excluded England from large fishing grounds where her boats had operated for many years. Next Iceland and England were parties to a dispute resulting from Iceland declaring certain waters, formerly regarded as open, to be closed to free fishing.

Other Disputes

In quick succession, there followed other disputes involving definitions of territorial waters. Korea versus Japan; Russia versus Japan; Arab countries versus Israel; Japan versus Australia; Indonesia versus Japan; Mexico versus the United States; Chile and Peru versus the United States. Of all claims regarding territorial waters, the most extreme are those of Chile, Ecuador and Peru who assert their complete ownership and control over the waters (and their products) from their shoreline out to 200 miles, or to the limits of the continental shelf, whichever is greater.

Such drastic action alarmed the United States, and this country tried, unsuccessfully, to reach a reasonable solution. These attempts took place

LIVING RESOURCES OF THE SEA *cannot be hoarded. If they are not used, they are eaten by others or else die. Thus they dissolve back into the food chain, yielding no benefit to mankind. Nations with potential fisheries should therefore provide for their rational exploitation. On the other hand, in pursuit of fishing, numerous countries, since World War II, have broken the "unwritten law" relating to the width of the territorial sea. From the classic three-mile limit, boundaries have been claimed from 4 to 200 miles out, and restrictions placed on foreign fishing vessels. (Miami Marine Laboratory)*

first at a conference in Santiago in 1955, and later through the Organization of American States in Mexico City in 1955, and at Ciudad Trujillo in 1956.

U. N. Sets Up Machinery

Meanwhile, the International Law Commission had spent several years considering the worldwide problem. It became more and more clear that technical questions, such as fishery conservation, were involved, and jurists would require assistance from fishery scientists. Accordingly, on December 14, 1954, the General Assembly of the United Nations provided for an "International Technical Conference on the Conservation of the Living Resources of the Sea," to advise the International Law Commission concerning scientific matters relating to fishery conservation.

This conference concluded on May 10, 1955, and was able to reach agreement on several vital points. These included a definition of the objectives of fishery conservation, agreement on the kind of research necessary on marine resources, and the principles on which international conservation treaties should be based. Agreement on the rights of coastal states was not so easy, and on this the report to the International Law Commission was forced to state that "the Conference . . . was more or less evenly divided."

Nonetheless, the conference was hailed as accomplishing important results, and the air was cleared in several vital areas. The Conference report undoubtedly influenced the ILC, and the International Law Commission report, sent to the General Assembly in final form in 1956, will surely influence the nature of the final code on the law of the sea, as it is eventually adopted by the community of nations.

ILC Suggests 12-Mile Maximum

The ILC report stated that, while there was no general agreement that the width of the territorial sea should be three miles, international law does not justify claims exceeding twelve miles. The Commission took no stand as to what distance between three and twelve miles should be adopted as the final one.

But the decision as to the width of the territorial sea will not come easily. For example, what consideration, if any, should be given to "special interests" which a nation may have in waters off its own coast?

It is not difficult to predict the reactions of a country when the ocean is yielding wealth to foreign boats off its doorstep, even though the local country is not fishing the area at all, or is conducting fishing at a level much below that allowable by good conservation. Local interest tends to restrict all fishing as far as possible for its own nationals, and to attempt to increase the area of its influence offshore for this purpose.

Let Us Not Underfish

But the wider interest of the whole community of nations is that fish should not be lost by underfishing. Living resources of the sea cannot be hoarded. If they are not used they are eaten by others or else die. Thus they dissolve back into the food chain,

yielding no benefit to mankind. Yet losses of fish as a result of underfishing this year may be followed by other losses due to overfishing next year, and a small nation hoping some day to share in the yield of the fishery off its shores has every reason to be concerned about the welfare of this resource.

Clearly, then, nations operating offshore fisheries should provide for rational management of those fisheries. Usually this involves an international conservation commission, charged with the responsibility of research on the stocks of fish and, where necessary, the control of fisherman's activities to prevent overfishing. The United States follows this principle, being a party to eight active international fishery conservation treaties.

Should Others Exploit?

Let us now suppose that a stock of fish on the high seas has been under exploitation for a considerable time, has reached the limit to which it can be fished, and is being managed to maintain a steady yield. Should not some regard be given to countries which have fished on these stocks for years, and have voluntarily restricted the fishing of their nationals in order to maintain the yield of the fishery? When it has been shown scientifically that more fishing will deplete the stock, should fishermen of other countries be allowed to enter this fishery freely and to reap the benefit of years of self-denial?

It seems to be clear that the proposed international code should consider this kind of situation.

Earliest of fishery conservation treaties to which the United States was a party is the International Halibut Treaty, under which Canada and the United States have successfully built back a stock of halibut, severely overfished in the 1930's, to a position where it yields as much as it did at its peak in the early 1920's. Furthermore, this increased catch is now made with two months of fishing, instead of the twelve months it took formerly.

This was done by obliging the fishermen of Canada and the United States to restrict their fishing drastically. It is quite unreasonable that boats of other countries should now be allowed to come into this fishery —even though the fish are taken on the high seas—and the United States position is that these other countries should abstain from such long-established and managed fisheries. This "abstention" principle is a basic part of the United States-Canadian-Japanese fisheries treaty of 1953.

Questions of the width of the territorial sea become involved also in matters other than fisheries. There is the problem of the ownership of mineral resources, principally oil, in the continental shelf. It is generally conceded that a country has full ownership and control over such resources out to a depth of 100 meters (about 200 fathoms) and this has complicated the fisheries question, since some countries have used this agreement to justify claiming the water above the shelf. Then the problems of "innocent passage" of ships and "hot pursuit" of supposed malefactors

THE RIGHT OF "INNOCENT PASSAGE" *into the Gulf of Aqaba was denied to Israeli ships by Egyptian guns. Before this problem could be resolved by law, fighting between Egypt and Israel flared in the Sinai peninsula. One result of this brief campaign was the demolition of the Egyptian batteries and the opening of Israel's southern port of Eliat, which promptly experienced a boom. (Israel Office of Information)*

become involved, as do questions of the ownership and control of the air above the territorial sea.

The recent Geneva Conference was the most important international meeting ever held as far as fisheries are concerned. Its results, when they are acted upon by the United Nations, will affect the activities of the commercial and pleasure boat fleets of every nation. The Conference has an even wider significance—it is the first attempt by the International Law Commission to codify international law. Its success in this regard, and the respect paid to the code by the nations of the world, may well be considered a stepping stone to peace.

Contents of Volume 3

REGULAR PAID-UP members of the Foundation have already received copies of *Contents, Volume 3, 1957, Numbers 1-4,* containing a listing of all articles, authors, and classification of articles published between March, 1957, and November, 1957. Others wishing *Contents* may receive a copy without charge by writing to Membership Secretary, I.O.F., 439 Anastasia Ave., Coral Gables 34, Florida.

DESPITE ITS NAME, *Shroud Key is a kaleidoscope of color from the air. Dark patches of variable size in Exuma Sound (foreground) are reefs. Where sand underlies the water, the color ranges from pale greens to vivid turquoise, grading off to deep blue as the depth increases. Tidal channels, cutting across the island, are bordered by the unique red mangrove. (Russ Kinne)*

Bahamian Land-And-Sea Park

By JOHN E. RANDALL AND CARLETON RAY

NEPTUNE'S underwater realm has intrigued man for centuries. But only in recent years, with the advent of the face mask, rubber flippers, aqualungs, spear guns, and underwater cameras, has man been able to venture freely beneath the surface in numbers and with reasonable safety.

Skindiving, as this new activity is called, has enjoyed phenomenal growth, and its popularity is understandable. In addition to such special interests as photography, spearfishing, and scientific study, there is the fascination of exploring the unknown—the exciting prospect of venturing into a whole new world which Nature did not intend for man.

Element of Danger, too

Undeniably, an element of danger exists, and this turns venture into adventure. But, to many, the most re-

warding aspect of undersea life is its aesthetic appeal, which reaches a breath-taking climax on reefs in clear tropic seas. Branching corals, graceful sea fans and sea feathers, odd sponges, armoured crustaceans, and brightly-hued fishes present a kaleidoscopic image of natural beauty and activity unexcelled on earth.

Sites of grandeur and beauty on land have frequently been set aside as public parks, reserves, or monuments, so that they may be safeguarded from encroachments of man's civilization and to provide recreational areas. "Can not this same concept be applied underseas?" asks a group of far-sighted persons in the Bahama Islands, a British Colony located east of Florida, which contains some of the most spectacular "sea gardens" in the world.

Are Marine Forms in Jeopardy?

Before answering this question, let us compare terrestrial and marine life in terms of conservation. If marine forms are in jeopardy, could they be saved from possible extinction by setting up a sanctuary, as one might for wildlife on land? The seas are vast, and most marine animals are widely distributed. Generally speaking, this distribution is effected by dispersal of tiny larval stages in ocean currents, and not by movement of adults as we find on land.

Thus preservation in a restricted area of the sea will ordinarily have negligible effect on the survival of species. But we may apply the idea of conservation in small areas of the sea to individuals. If fishes such as groupers, which are believed to be slow-growing, are taken from an area, or if corals (which likewise develop over periods of many years) are wantonly removed by fishermen or curio dealers, the area will indeed be adversely affected and might take years to recover, even though the species as a whole continue to exist.

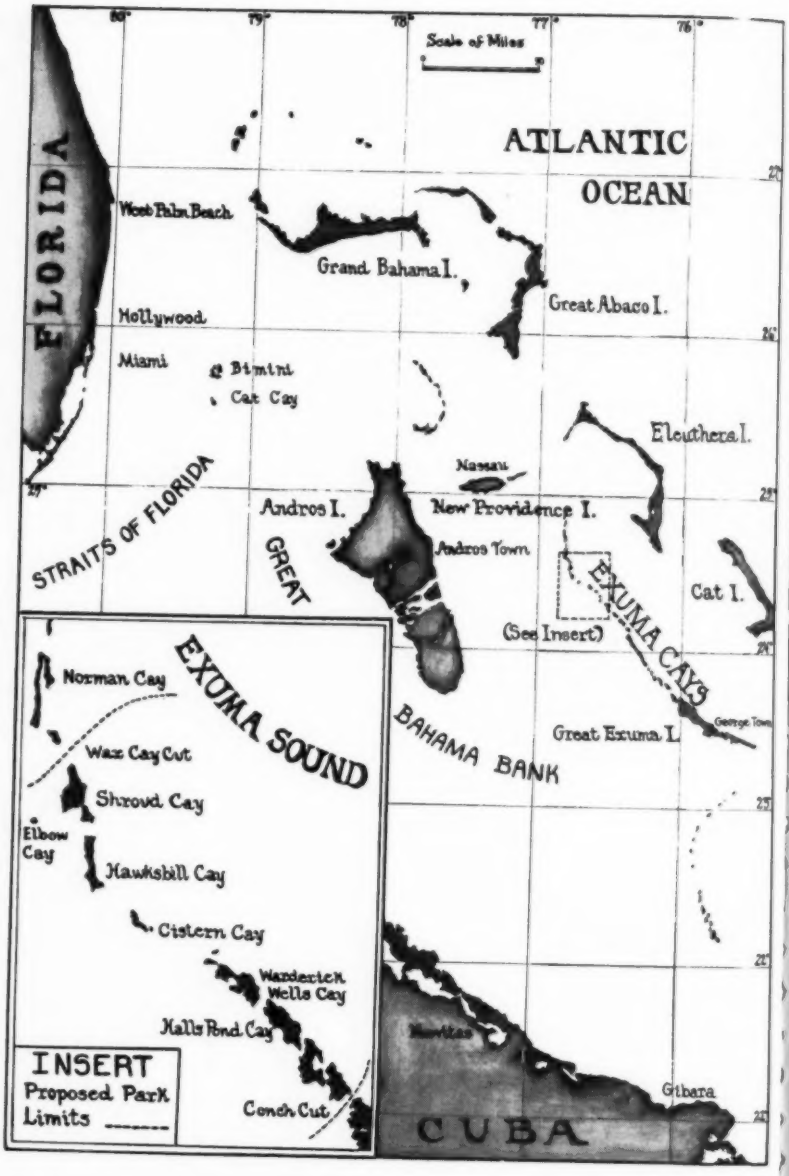
Man Despoils Undersea Life

Man may disturb marine environments in other ways than the taking of fishes, crustaceans, corals, shells and the like. Harbor and real estate developments, the dumping of debris, and pollution may all contribute to the destruction of undersea life. Therefore, select reef areas, especially if they are not too distant from populous regions, deserve special steps for preservation. Marine biologists are particularly interested, because they are anxious to see that some reefs are maintained in their primordial state.

Of course, protection might be afforded by the ordinary conservation rules and regulations, so that the establishment of a park might not be necessary. But a park association does serve to interest the general public in the problem, and to provide an organization which helps to maintain facilities for visitors.

Exuma Cays, a Promising Site

Accordingly, a plan has been devised to set aside a section of the Exuma Cays and surrounding waters in the south-central Bahamas, as a land-and-sea national park. Chief proponents of this commendable proposal are Colonel Ilia Tolstoy, grandson of the famous pre-Communist Russian novelist, and Carleton Ray, co-author of this article.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OCEAN
FLORIDA
West Palm Beach
Grand Bahama I.
Great Abaco I.
Hollywood
Miami
Bimini
Cat Cay
Eleuthera I.
Nassau
STRAITS OF FLORIDA
Andros I.
New Providence I.
GREAT
Andros Town
EXUMA CAYS
Cat I.
(See Insert)
EXUMA SOUND
Norman Cay
George Town
Great Exuma I.
BAHAMA BANK
Wax Cay Cut
Shroud Cay
Elbow Cay
Hawksbill Cay
Cistern Cay
Wanderick Wells Cay
Halls Pond Cay
Conch Cut
INSERT
Proposed Park Limits
Gibara
CUBA

S THE MAP INDICATES, *the proposed Exuma park area should be easily accessible via charter boats from Nassau, and to yachts out of Florida and Cuba. The insert (lower left) shows the principal islands and channels to be included within the park. (I.O.F. map by Rosemary Latimore)*

The idea of an underwater preserve though unusual is not new. Dr. Gilbert L. Voss of The Marine Laboratory, University of Miami, and others have recommended that the boundary of the Everglades National Park in Florida be extended to include Key Largo, so that the lovely reefs such as Largo Dry Rocks might be included within the park. The sea gardens around Fort Jefferson National Monument, located on Dry Tortugas in the Gulf of Mexico, sixty miles west of Key West, are an integral part of the monument. The National Park Service considers these as an important asset and plans to make it possible for people to see and enjoy this underwater spectacle.

Marine areas adjacent to the Virgin Islands National Park are now being evaluated for possible incorporation into the park. Underwater preserves have been established at Cabrillo National Monument and Channel Islands National Monument in California. Jacques Cousteau, author of *The Silent World,* is trying to establish an undersea sanctuary near the Museum at Monaco. The Eil Malk area of the Palau Islands, Trust Territory of the Pacific, has been set aside as a marine preserve.

Sea Principal Attraction

The sea and its marine life will be the principal attraction of the park in the Exuma Cays, if it materializes. The cays themselves consist of a chain of about forty low islands and innumerable smaller islets and rocks, extending about 130 miles from a point about 25 miles east and slightly south of New Providence Island. Perched on the eastern edge of the Grand Bahama Bank, the Exumas lie between vast shoals to the west and the great depths of Exuma Sound to the east.

Deep tidal channels cut between the cays and link the bank with Exuma Sound. Seen from the air, the crystal seas vary in glowing shades from emerald green over the sand flats, through turquoise and blue in the cuts, to the deep blue of the sound. Stretches of turtle grass darken the sea like cloud shadows, and reef patches appear yellowish brown where they come close to the surface.

Clearest of Waters

The Exumas have long been a favorite haunt of charter boat captains operating out of Nassau. There are good anchorages and splendid beaches of fine white oolite sand. Fishing is excellent; conch, badly in need of conservation elsewhere, are still abundant on grass flats. The clarity of the water, as elsewhere in the Bahamas, is exceptional. When the seas are calm, the boundary of sea and air is at times almost imperceptible, conveying the illusion that boats are suspended in one uniform medium.

Choice of the site for an Exumas park hinged largely upon available government land. Within the 22-mile-long area, which extends from Wax

Cay Cut on the north to Conch Cut on the south, are ten islands of more than a mile in length. Seven of these islands belong to the Crown. Three are under lease, but Mr. William Grant, the leasee of Cistern Cay, has enthusiastically included his own island as an integral part of the park. All of the waters around these islands, including those under lease, are within the proposed park boundary.

Recall Early Days of Florida Keys

Most of the islands in this part of the Exumas are uninhabited and essentially unexploited by man. The bulk of the population of the Exumas is located on Great Exuma Island, in the southern part of the chain, where George Town is the principal settlement. The Exumas recall, in fact, the Florida Keys thirty or more years ago. Because the Bahamas are being built up and developed with startling rapidity, the same fate may befall these islands (which owe so much of their charm to seclusion) as has the Florida Keys, now immersed in a neon glow. If some segment of the Bahamas is to be maintained in a primitive state, the time to establish it is now.

PART OF THE SURVEY TEAM, *which inspected the Exuma Cays Park area January, 1958, examines a chart on board the survey ship. In the group, left to right, are: Dr. John E. Randall, Oris S. Russell, Daniel B. Beard, Colonel Ilia Tolstoy, Dr. Donald Squires and Dr. Carleton Ray. While some members of the party made an inventory of shore life, others dived among the adjacent coral and other marine growths. (Russ Kinne)*

Early in 1958, a survey team visited the proposed park site. Included were Col. Ilia Tolstoy; Dr. Carleton Ray of the New York Aquarium; Hon. Herbert McKinney, former member of the Legislature of the Bahamas; Oris Russell, Director of Agriculture in the Bahamas; Dr. John E. Randall, ichthyologist from The Marine Laboratory, University of Miami; Dr. Donald Squires, coral specialist from the American Museum of Natural History; Daniel B. Beard, former superintendent of Everglades National Park; Robert Allen of the Audubon Society; John O'Reilly of *Sports Illustrated* and Russ Kinne, photographer.

Meetings Held in Nassau

Prior to and immediately following the week's survey, meetings were held in Nassau discussing the establishment of the park. Among those attending and contributing valuable advice were Dr. F. G. Walton Smith, vice president of the Foundation; the Hon. Godfrey Higgs, member of the Bahama Legislature; Carl Livingston; R. H. Symonette, of Nassau, and Representative in the Legislature from the Exumas; Charles C. G. Chaplin, part-time resident of Nassau who is sponsoring the preparation of a book on the fishes of the Bahamas; and Donald McCarthy of the Bahamas Development Board.

Shroud Key Largest

The consensus is that the park site is a good one, although it would be improved by the addition of Norman's Cay, which lies immediately to the north of the proposed park region. Norman's Cay contains a large inner basin which would make an ideal anchorage. Only a small amount of dredging would be needed to enlarge the entrance.

Perhaps the most interesting island in the area is Shroud Cay (also known as Hungry Hall Cay). The largest, three miles long and nearly two miles wide, it is interlaced with tidal channels of crystalline water lined with red mangroves. The channels make an interesting motor boat excursion.

Off the eastern side of Shroud Cay lie the most beautiful reefs in the area. Not far from shore, in depths less than 15 feet, reef patches with stands of staghorn coral and swaying purple and yellow sea fans and other gorgonians may be explored. Large schools of bright yellow French grunts (also called yellow grunts) dominate the fish fauna. Snappers are also numerous. The stately Nassau grouper and large yellowfin rockfish show little fear of approaching swimmers and make ideal subjects for the underwater cameraman.

Panorama of Colored Fishes

Lovely angel fishes of many hues swim by with regal airs, and small colorful wrasses scuttle about constantly on the reefs. Bright red squirrel fish dart in and out among interstices in the coral. Gaudy parrot fishes and surgeon fishes graze endlessly on the rocky ledges. Brilliant blue demoiselles hover over masses of coral, and bizarre trumpet fish may at times be seen standing on their heads among the gorgonians.

Land vegetation, although not spectacular, is not without interest, and includes red mangrove, sabal pal-

ROMANCE UNDER THE GORGONIANS. *Submarine life is full of surprises, such as this pair of French grunts about to kiss each other. The inside of the mouths of this and other grunts is orange-red. The fish often face each other with open jaws, press their lips together and push against one another. Staghorn coral is growing in the background to the left. Gorgonians, sometimes called soft corals, are seen to the right. (Carleton Ray)*

metto, silver thatch palm, sea grape, lignum vitae, dildo cactus, and *Epidendrum* orchid.

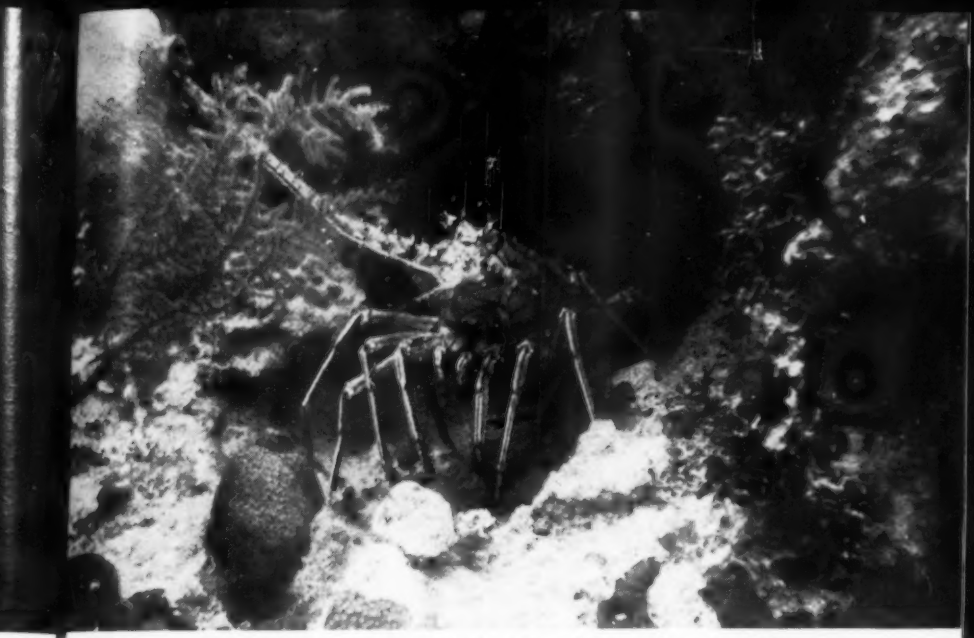
More than 200 species of birds have been recorded from the Bahamas, but only about half nest in the islands, and not all of these are resident throughout the year. Bananaquit, Woodstar hummingbird, Bahamian mocking bird, palm warbler, red-legged thrush, royal tern, osprey, great blue heron, plovers and other shore birds have been seen in the park area.

The white-crowned pigeon, once plentiful, is still being shot, both for food and for sport, and has disappeared from many of its former haunts. It responds well to protection, however, and, with the creation of a park, could probably be brought back.

May Be New Flamingo Home

The most captivating of Bahamian birds is the flamingo. Columbus noted these "tall red birds" on his first voyage to the New World. The famous ornithologist, Dr. Frank Chapman, once wrote: "There are birds larger than the flamingo, and birds with more brilliant plumage, but no other bird is so brightly colored and no other brightly colored bird is so large."

Flamingoes now nest in only two places in the Bahamas, Andros and Inagua, where they are protected from man by law. They once nested



ALTHOUGH LACKING THE LARGE CLAWS *of the Maine lobster, the spiny lobster or crawfish of Bahamian waters is every bit as tasty. Here he stands guard before his underwater home in the proposed Exuma park area. Some specimens weigh as much as ten pounds. More than ten species of spiny lobsters are found in different parts of the world. (Russ Kinne)*

in the Exumas and conceivably could be established in the park area. The most suitable location, however, is on Norman's Cay.

There are no venomous snakes. The most common snake is the Bahamian racer. Of the smaller lizards, the most interesting is the curly-tailed lizard which is surprisingly unafraid of man. The native iguana, which reaches a length of four feet, has been nearly exterminated because of its food value. It is now found only on the most isolated cays. Repopulation of the park cays with this iguana is one of the primary conservation measures of the park plan.

Turtles Need Protection

The green turtle, once common in the Bahamas and a major food item, is rare now. The hawksbill turtle is being ardently hunted for its shell and for food, although the inferior loggerhead is the main ingredient of island turtle stew these days. Some means of preservation of turtle populations have long been overdue in the entire West Indies region.

Although a strong case for a national park in the Exumas for the purpose of conservation of both marine and terrestrial life can be made, the other basic purpose of a park, recreation, is not yet as well justified. Even though the Exumas are closer to Nassau than most outlying islands in the Bahamas, they are not apt to be visited by many tourists, other than yachtsmen. If, however, the park is established now, its recreational

value will be more fully appreciated years hence, when the rest of the Bahamas may be overrun with cottages and resorts.

Exciting Work-Boat Race

The waters around the Exumas adjacent to the proposed Park come into the news each April as the scene of the annual "Out Island Regatta." This is strictly a work-boat sailing race, limited to Bahamian skippers who spend the rest of the year hauling cargos of fish, conch, lobster, vegetables and passengers among the islands. In 1958, the fifth annual Regatta attracted 65 boats to George Town from all parts of the Bahamas, as well as a fleet of sail and power yachts from Nassau and Florida ports to witness this unique sailing event.

Competition, spurred by $3,000 in prizes and silver, is keen, particularly at the hectic beginning of the race—a marine version of sports car racing's LeMans start. There is only one ground rule: if two boats are in danger of collision, both must come about. Sometimes both skippers delay this maneuver until it is too late to avoid a bump, to the accompaniment of flying splinters and a few choice epithets!

While not within the proposed Exuma Park area, it is hoped also that the sea gardens in the immediate vicinity of Nassau, such as those off Athol or Rose Islands, may ultimately be set aside in the same manner as proposed for the Exumas, to eliminate excessive fishing and collecting. This will benefit the many local and visiting skin divers, most of whom are more interested in observing and photographing undersea life than hunting and destroying.

Important Fisheries Conference

ONE OF THE most important technical conferences of 1958 will be held in London, September 8 to 13. Sponsored by the Food and Agriculture Organization of the United Nations, the meeting on "Costs and Earnings of Fishing Enterprises" will consider the greater part now played by governments in the maintenance and development of fishing industries, and how this affects the individual fishermen, boat owners, and processors.

Governmental assistance is being given to fishing enterprises in a great variety of ways—subsidies and credit schemes, remission of taxes and duties, preferential foreign exchange treatment, provision of port and shore facilities, insurance schemes, price support and marketing measures, etc. Some schemes favor, some discriminate against certain groups and types of enterprises, and encourage or discourage the use of certain fishing methods and equipment. The FAO meeting thus has an agenda of primary importance, and its papers and debate will be awaited with considerable interest by the fisheries industry.

ABERDEEN'S PICTURESQUE INNER HARBOR, *lined with warehouses, ship's factors, and old sail lofts, is home port for much of Scotland's important fisheries. Here you will see fishing craft of many types. In the foreground, the research vessel* CLUPEA *puts to sea. (Associated Newspapers, Ltd.)*

Of Ships and Herring Runs

by ROBERT ELLIS

A FAMILIAR SIGHT to the fishermen landing their catches at Aberdeen's ancient fish market is a handsome group of buildings on the south side of the harbor entrance. These house one of the famous Marine Laboratories of Scotland. Both ashore and afloat the staff are continually studying the science of the sea in waters fished by or potentially important to the Scottish fishing fleet.

Pioneered in Oceanographic Research

Cruises of the famous oceanographic research vessels, *Challenger* and *Scotia,* during the last century, are sufficient testimony to Scotland's early association with oceanographic studies. Her concern for conservation of marine resources and welfare of the fishing industry is further illustrated by the many commissions set up to deal with fisheries problems since about the middle of the last century. As far back as the early 1800's statistics of some herring products were collected. Perhaps this early realization of the value of fishery statistics has resulted in Scotland having some of the best marine life data available today.

Scotland entered the fishery research field about 1836, when a scientist was asked to determine if herring and sprat belonged to different species. In 1842 a study of the life history of the herring began. Other problems, concerning international

fisheries regulations and the introduction of trawling to the industry, were also studied.

Fisheries Management and Research

A major step in the organization of fisheries management and research was the formation, in 1882, of the Fishery Research Board for Scotland. This Board reported annually and investigated problems for the Secretary of State for Scotland, as its successor does today.

Under the Fishery Research Board, temporary research laboratories were set up in different parts of Scotland. Field studies conducted at these laboratories soon showed the need for a detailed knowledge of the biology of important food fishes.

In 1886, in response to a demand for a study of the allegedly harmful effects of trawling, the Board acquired its first research vessel, the 30 ton yacht *Garland*.

Demands of various research problems exceeded the facilities available, and in 1899 a permanent center for fishery research was set up in Aberdeen, close to the site of the present Marine Laboratory.

Drift Bottles Plot Currents

Despite scanty facilities, progress was made and several biologists, well known in fishery research, were associated with the Aberdeen laboratory. Many of their discoveries have stood the test of time, and are still used by fishery research workers, such as the use of drift bottles to plot surface currents, and of a fine meshed cover over the bag of the trawl to collect the animals which escape through the trawl meshes. The latter technique is favored today, for example, by biologists of The Marine Laboratory, University of Miami, in their studies on the escape of shrimp through trawl meshes.

The gradual expansion of marine research facilities in Scotland was paralleled by similar developments in England and in other European countries. These studies were conducted largely in isolation until the formation, in 1899, of the Permanent International Council for the Exploration of the Sea. The objective of this Council was to coordinate research activities in Europe, with a view to achieving rational exploration of the sea.

First Fishery Meetings Set up Areas for Study

This Council inaugurated annual meetings of fishery scientists, organized the problems to be studied and provided a platform where results could be reported and discussed. Within this international organization Scotland's chief sphere of investigations was set up in the upper North Sea, while scientists from other countries studied other parts of the area. The studies covered life history studies of the important food fishes and associated plankton and hydrographic observations.

Each year, a succession of scientific reports were prepared by the relatively small staff at the Aberdeen laboratory. Noteworthy among these reports was one by Dr. Bowman on mesh selection in trawls and seines. This subject is still receiving attention in laboratories throughout the world.

TWO SCIENTIFIC OFFICERS *from the Marine Laboratory visit the Aberdeen fish market twice a week to measure the haddock catches and to take scale samples. From these, and other data obtained afloat, the Laboratory is gradually learning more about the cycle of life in the sea and the factors which affect fish population in the North Atlantic area. During the long history of the Aberdeen Marine Laboratory, its staff has pioneered techniques of fishery science and contributed vital facts, important not only to our knowledge of the ocean, but also to the fishing industry of Scotland and many other countries. (Central Office of Information)*

due to its important bearing on fisheries management legislation.

Overfishing—Fact or Fiction?

Many scientists associated with the International Council in its early years believed that fish stocks could not be seriously depleted by commercial exploitation and hence regulations were unnecessary except to resolve local disputes. Several experiments were conducted to obtain more data. Dr. Fulton, at the Aberdeen laboratory, proved, by tagging plaice, that a significant percentage of the available stocks were being taken by commercial fishing activities.

Research activities at the Aberdeen laboratory were interrupted during the first World War. In the years prior to the war, the production of the principal food fishes showed a gradual decline, but scarcely enough to cause serious concern. Fishing was greatly restricted during the war and the stocks were thus "rested."

When fishing resumed, the detailed landings statistics being collected at this time showed that not only was the total catch higher after the war than before, but the catch per hour was also higher. This evidence suggested that prior to the war the stocks of some species of fish had been overexploited and conservation measures were required.

Research between the Wars

Between the wars, Aberdeen biologists engaged in studying age and growth, spawning habits, distribution and density and other aspects of the life history of the haddock, herring, lemon soles and other food fishes, and the effect of different fishing gears on these fishes. Regular cruises were made on the *Goldseeker,* which had replaced the *Garland* in 1902, and on the *Explorer,* which had replaced *Goldseeker* in 1922. On these cruises fish stocks were sampled and plankton and hydrographic observations were taken. When the Faroe Islands and Iceland grounds were exploited by Scottish fishermen, Aberdeen scientists also made observations in these areas.

During the inter - war period, a great deal of valuable basic and applied research was reported in the laboratory's publications or in the publications of the International Council. Among these were the following: Dr. Thompson's study of the life history of the haddock, the work of Dr. Clark (Director from 1935 to 1948) on skates and rays, and Dr. Tait's treatise on ocean currents in and around the northern North Sea.

Dr. Bowman, Dr. Thompson and others in the Moray Firth (a large bay on the east coast of Scotland) showed that this was the principal nursery area of the haddock, whose adult stages occur in the northern North Sea. As a result of these studies, the Moray Firth was closed to British trawlers, which had previously destroyed large quantities of immature haddock.

By 1933, as a result of research on mesh selection conducted at the Aberdeen laboratory and elsewhere, the United Kingdom government was persuaded of the need for adopting minimum mesh sizes and minimum market landings sizes to prevent the destruction of the small fishes, the

marketable stocks of the future. By 1939 a measure of international agreement was reached, but the war prevented the measures being implemented.

Period of Rapid Expansion

Despite the progress made before World War II in fisheries regulations, stocks of haddock, for example, declined gradually. While stocks again rested during the war and the production of fisheries was high immediately after it, it was clear that drastic measures, based upon scientific research, would be required to forestall a decline due to over-exploitation.

The Aberdeen laboratory (since 1939 under the administrative direction of the Scottish Home Department) rapidly increased its staff to its present complement of about fifty-five scientific personnel, exclusive of vessel crews and administrative staff. A further team of workers was recruited to study fresh water problems. The number of research vessels was increased, so that by 1951 the fleet consisted of the *Scotia* (166 ft.), *Explorer* (135 ft.), and the *Silver Scout* (65 ft.). The latter ship, operated by the Herring Industry Board, was used by the Aberdeen laboratory for part of the year. In 1948, on the

A WELL-EQUIPPED CHEMICAL LABORATORY *aboard a research ship. Chemical analyses must often be made at sea in order to determine the abundance or lack of nutrients in the water, as well as the relationship of water movements to the distribution of food elements in the area under study. (A. J. Strachen, Aberdeen)*

VISITORS AS WELL AS SCIENTISTS *find this modern aquarium at the Aberdeen Marine Laboratory interesting. Complete with tanks and circulating seawater, the aquarium keeps specimens alive for study and experiments. (Ministry of Works)*

retirement of Dr. R. S. Clark, Dr. C. E. Lucas became director of the laboratory.

As the *Explorer* was old and could no longer fill the requirements, plans for a replacement were drawn up. The increased staff had strained the available research facilities. Plans have also been drawn for a building extension. On June 21, 1955, a new research vessel, continuing the name *Explorer,* was commissioned, and the laboratory extension buildings were opened.

The new *Explorer* is of the rugged Arctic trawler class. Her length between perpendiculars is 183 ft. 6 in., breadth 32 ft. and 14 ft. draught. She is driven by oil-fired steam with single screw, and has a cruising range of about 35 days. Other equipment includes gyrocompass, radar, radio, D.F., echo sounders, a powerful trawl winch and three winches for research projects. Also provided are an icing room and a quick freezing room, three large and well equipped laboratories, and accommodation for eight scientists. She is planned to be adaptable not only to Scotland's present research requirements, but also for the future, as Scottish fishing vessels penetrate further into the storm-swept north and west Atlantic Ocean.

The new building also was planned to fit the needs of an expanding research program. It boasts aquarium facilities, constant temperature, and ample storage space, in addition to

chemical and biological laboratory space.

Of the many projects being actively studied at present at the Aberdeen laboratory only a few can be discussed here.

The fishing industry's need for improved fishing methods and gears led to the formation in the laboratory of a Gear Development Section, composed of engineers and biologists. The projects studied by this group are the behavior of fishing gears, both by making measurements with specially designed instruments, and directly by observation and photography.

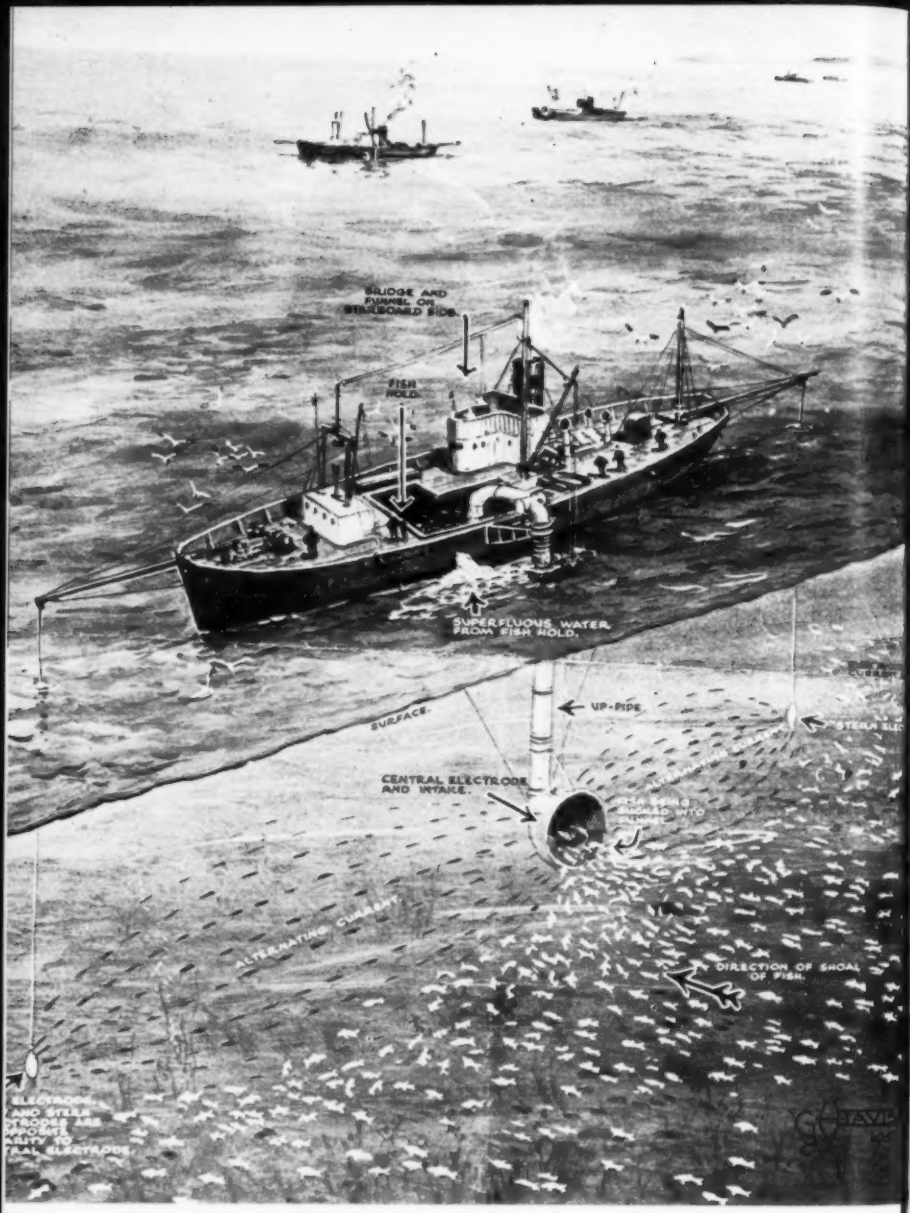
"Fish Reaction" Studied

Reaction of the fish to the gear is also being studied by staff members trained in underwater diving techniques. Information of this kind can lead to the development of equipment which will catch fish more efficiently and economically.

Probably the first underwater photographs of a trawl were obtained by the late Lt. Cmdr. H. J. Hodges, R.N., a British naval frogman, when working with the Aberdeen laboratory. Later cooperation between Lt. Cmdr. Hodges and the laboratory resulted in the production of a highly successful and popular film, "Fish and the Seine Net," shown throughout the world to demonstrate the behavior of gear and the reaction of fish to the gear. This film and others made in Scotland demonstrate clearly that the meshes of trawls and seines remain wide open while gears are operating, an important consideration in the use of mesh regulations to restrict the capture of undersized fish.

Because the herring is all-important to the Scottish fisherman, emphasis is placed on studies of this vital food fish. The "herring team" consists of specialists in all branches of oceanography, including hydrography, plankton, fish biology, gear development, instrument design and mathematical analysis. This project is coordinated by Mr. B. B. Parrish. In addition to studying the life history of the herring, the team seeks improved methods of detecting herring by echo sounders and other instruments, better methods of catching them, including pelagic trawls, and the relation of herring distribution and density to plankton and hydrographic changes. Regular cruises are made on research vessels and instruments are operated continuously to try to locate herring schools. When such schools are observed the information is relayed to the fishing fleet by radio. Many fishermen take advantage of this service, and make good catches because of it.

During the long history of the Aberdeen laboratory, its staff has pioneered techniques of fishery science and has contributed vital facts, important not only to our knowledge of the oceans, but also to the fishing industry of Scotland and many other countries. The research programs continue to be closely coordinated with those of the other countries of northern Europe, associated in the International Council for the Exploration of the Sea and, since 1950, with the member countries of the International Commission for the North Atlantic Fisheries.



"AND WELCOME LITTLE FISHES IN!" *A drawing of a Russian method of "electrical fishing," using alternating current. As soon as the current is switched on, the shoal of fishes is attracted to the funnel which carries the central electrode. They are then sucked up a pipe by a pump, and fall into the hold, where the water drains into the sea. (Drawing by G. H. Davis. Reproduced with the special permission of the* Illustrated London News)

A Shocking Way to Fish!

By C. P. IDYLL, *Research Professor*
Marine Laboratory, University of Miami

FISHERMEN as a class are generally very practical. In fact, they are frequently accused of over-conservatism and of resisting improvements in the conduct of their trade. Hence the idea of catching fish by flipping an electrical switch, instead of pulling in a seine, is a pretty upsetting one to many of them.

Nonetheless, if imagination and persistence pay off, tomorrow's sea hunters may very well throw away their hooks and nets and substitute amps and volts.

"Man from Mars" Talk?

It seems like "Man-from-Mars" talk, this herding fish into a tight mass, without a net, and then pumping them into the hold of a waiting boat. But this kind of talk and lots more that is equally fantastic are going the rounds of fishing circles. Electrical fishing is a live-wire topic, and a fascinating one.

Maybe you remember one of the simpler experiments you carried out in the high school physics laboratory. You scattered iron filings on a piece of paper under which there was a magnet. As you tapped the paper, the iron filings lined up in a definite pattern, branching out in what the physics teacher called "lines of force," from one pole of the magnet to the other.

The first strange fact of many connected with electrical fishing is that live fish can react very much like those long-ago iron filings, and line up in an electrical field, facing the positive pole. They don't do it because they like this position, but because they have no choice. They are compelled to be parallel with the lines of force of the electrical field, exactly as the iron filings were jerked into position with a tap of the finger on the paper, and as surely as though they had no more power of independent movement than the inert iron.

Then comes the next miracle. Instead of staying in one spot, the fish now begins to move inexorably toward the positive pole that it turned to face when the current was flicked on. The fish will continue to move toward the anode as long as the current persists, and if too much "juice" or time is involved, the fish will die. If he escapes this ultimate disaster and the current is turned off, the fish is released from the spell of the electrons and can flee with a frightened flip of his tail.

Fresh Water Electrical Fishing A Success

But suppose the current is not turned off, and the fish is stunned near the electrode. Then it, and maybe thousands of its brothers, can be scooped up by an eager fisherman.

This sort of thing is not a dream for the future, but has been going on for years. So far, it has been successful only in fresh water. Sea fishing by electricity has so far baffled the engi-

neers, for reasons which we shall presently see.

The behavior of the fish described above is induced only under tidal ideal conditions. Actually there are various levels of reaction of fish to an electrical field, depending on the type of power of the current, on the kind and size of the fish and on the dissolved salt content of the water.

Jerking Reaction

The lowest level of reaction of fish to electrical currents is a mere perception of the electricity. This takes place at a very low current strength. The fish shows its awareness of the current by sudden jerks of the head and by moving its gills and fins more actively. Next, with more current, the fish may exhibit distress and a fright reaction. The animal may turn at right angles to the current direction, since this is the position where the least effect is felt, or it may dash wildly around.

If the current is D. C. (direct current) the amazing behavior described earlier is exhibited at a certain intensity, and the fish turns, facing the anode, or positive pole. Next an invisible but compulsive hand seems to push the fish forward, and it swims against its will toward the anode.

Electrotoxis Reaction

This reaction is called "electrotoxis," and may be followed by loss of consciousness, as the fish is stunned. Usually the fish now sinks, and in shallow water it lies on its side and stops breathing. This is "electronarcosis" and is followed by death if the current is allowed to persist.

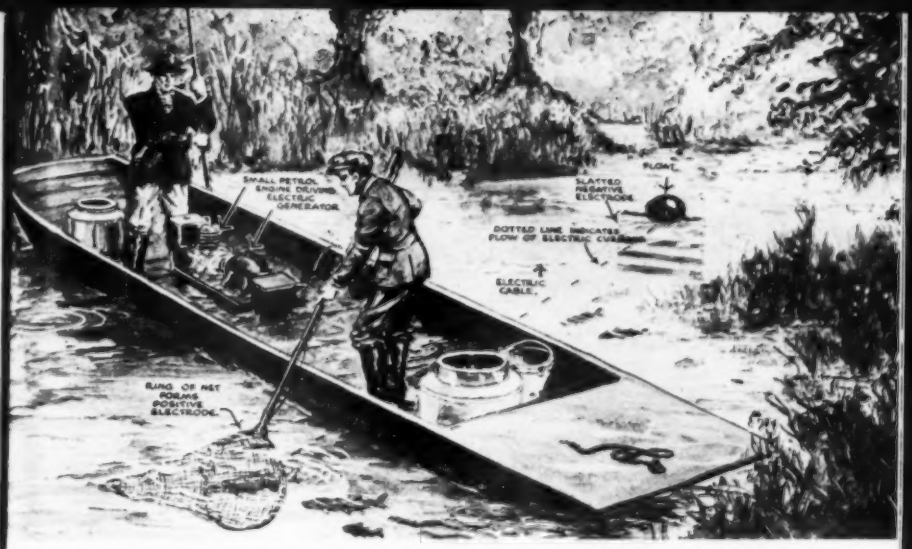
Death intervenes much more surely and quickly if alternating current is used instead of direct current, and the orientation behavior described above is not exhibited. Instead the A. C. current causes a cramp in the muscles of the fish, and this may be so severe that it wrenches the muscle away from the bone. Vertebrae are sometimes fractured and blood vessels are broken.

D. C. current does less harm to the fish and allows recovery if the fish escapes capture and is released. Its other main advantage, of course, is the ability to make the fish move toward the anode.

Electronic "Mesh Regulations"

Bigger fish are influenced more readily by electrical currents than small ones, and the amount of reaction is generally in proportion to the size of the fish, for a given current strength. Of course this leads to the interesting possibility of controlling the minimum size of fish caught, by proper control of the current characteristics—a sort of electronic "mesh regulation."

The influence of fish size on degree of response is a result of a greater voltage gradient between the head and the tail of bigger fish. This means that in water the voltage drops at a steady rate, and the farther the distance between two points in an electrical field, the greater is the voltage difference. Hence a big fish has a large difference in voltage between head and tail and is influenced more by the current than is a small fish with a smaller voltage difference. Fry and small fish may be unaffected by a cur-


SMALL PETROL ENGINE DRIVING ELECTRIC GENERATOR
SLATTED NEGATIVE ELECTRODE
FLOAT
DOTTED LINE INDICATES FLOW OF ELECTRIC CURRENT
ELECTRIC CABLE
RING OF NET FORMS POSITIVE ELECTRODE

ELECTRICAL FISHING IN FRESH WATER. *An experimental method of controlling "trash fish" in English trout streams uses direct current to weed out pike, grayling, eels and other unwanted species. The current (200 volts at 5 amps) does not harm the fish but brings them quickly to the net, the outer rim of which forms the positive electrode. (Drawing by G. H. Davis. Reproduced with the special permission of the* Illustrated London News)

rent which causes electrotoxis or even death to larger fish.

Where it Works Best

Considerable use has been made in fresh water of the reactivity of fish to electrical currents. In streams and lakes where seining or other collecting methods are difficult because of rough bottom, or dense vegetation or overhanging brush, fish have been collected by electricity for scientific study or for census purposes. Fish can be forced out of hiding places which would defy the efforts of seines or other ordinary collecting devices. Also, "rough" or undesirable fish can be eliminated by killing them with A. C. current.

This type of activity in fresh water is old hat by now, and dozens of devices have been designed and used. The size and depth of the stream and the type of soil and water have a great effect upon the operation of the apparatus, and this is one reason for the many types.

All the present types involve two electrodes, one connected to each pole of the generator. A Michigan apparatus consisted of metal electrodes mounted on wooden frames, and carried by two men about 15 feet apart.

Setting Up Electrical Field

Several one-man gears have been developed, using dry batteries to save weight, the apparatus being carried in a packsack. Current is carried to copper plate electrodes by wires on nine foot bamboo poles and the operator can set up an electrical field as he walks in the stream—in rubber boots of course! He works downstream, thrusting the electrodes into likely areas, including places unreachable

by other means. The fish caught in the electrical field are stunned and swept downstream into a net stretched for the purpose.

In Hungary, an apparatus has been developed which is operated from a boat whose copper-sheathed keel acts as the negative electrode. The anode is on the end of a wooden pole, and is a basket-shaped device covered with wire mesh. A man standing in the stern of the moving boat scoops up, in his metal basket, fish which have been attracted from distances of up to six feet. Cool weather, which made the fish sluggish, produced the best catches. One boat, fishing in the Nagyberek River, where ordinary fishing was impossible, caught 5½ tons of fish in six weeks.

Electrode in a Funnel

Commercial electrical fishing on a much larger scale is reported to be conducted in fresh water in Russia. Here a good-sized ship anchors in a river alongside a power plant, with cables between them laid along the river bottom. One electrode is a metal funnel, placed at the end of a big rubber hose. The other electrode is a metal plate supported in the water some distance from the ship by floats. Current is turned on and the fish between the electrodes are forced to swim to the funnel and are sucked up through the hose into the hold of the vessel. One trial produced 1100 pounds of good quality fish in 11 hours.

Salt Aids Conductivity

But now, what of this difference between the efficiency of electrical fishing in sea water as compared with fresh water? What has the added quantity of dissolved salt to do with the effect of the electrical currents?

Plenty, as it turns out, since the amount of salt determines the con-

HOW TO LURE THEM OUT *of the weeds, or from under rocks. Two workers wearing rubber waders and carrying electrodes can get into places where nets are useless. Experiments show that the bigger the fish the more susceptible it is to the current. Electrical fishing is sometimes used illegally by poachers, but fortunately the noise of the generator usually gives them away. (Drawing by G. H. Davis. Reproduced with the permission of the* Illustrated London News)

ductivity of the water: the more salt the greater the conductivity. Hence, water with much salt has a low resistance to electrical currents, and pure water has a high resistance. The range is great. Rainwater has a resistance of 1,000,000 ohms, mountain streams as high as 10,000 ohms, rivers 800 to 2,000 ohms, and sea water only about 9 to 20 ohms per cubic inch. The resistance of water decreases with a rise in temperature.

Of course a fish has its own resistance to the passage of an electrical current too, and it happens to lie between the values for salt water and those for fresh water. An average value of 200-400 ohms per cubic inch has been found for fish studied, so far.

Path of Least Resistance

Electrical currents take the path of least resistance, even as you and I, and when a current has a choice of passing through a fish with a resistance of, say, 300 ohms, or fresh water of 1,000 ohms, it zips through the fish. Contrary-wise, the same fish, with the 300 ohm resistance, will have less current passing through it if it is immersed in water of the open sea with a resistance of only 10 ohms. Thus, to achieve the same physiological effects as in streams and lakes, much more power has to be used to create the electrical field in sea water.

Despite a somewhat smaller voltage gradient being effective in sea water, other factors, including the greater spread of the field in water of high salinity, combine with the comparative resistance to make it necessary to develop from 50 to 500 times the power in sea water as in fresh water.

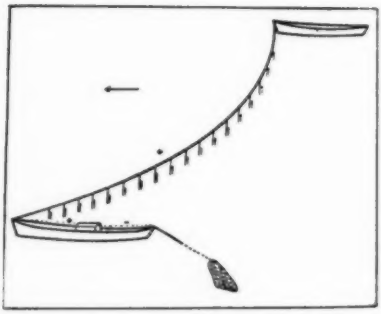
Brief "on"; Long "off"

We seem to have made a bad start in our program to fish electrically in the sea, but things improve from now on. It turns out that it is not necessary to leave the current on steadily—in fact better results in controlling fish movements are obtained by interrupting the current. Some of the most effective devices allow the current to be flowing considerably less time than it is turned off. Of course, this effects a proportionate saving in power. In some successful experiments the "on" period was only one millisecond while the "off" period was nine milliseconds (i.e. nine thousandths of a second). In other trials shocks of two to 15 milliseconds duration have been used alternating with current pauses of as much as 100 milliseconds.

Next, saving in power can be obtained by building the current up by charging a condenser through inductance; this can be done during the pauses between impulses. This results in a current pulse which has a sudden steep rise and a slow decay. This "pulse shape" is not the ideal one for producing maximum reaction from the fish, since experiments show that a rectangular pulse (i.e. rising quickly, maintaining its intensity for a brief space and falling equally quickly) gives the best results.

Pulsed Current Cheaper

This technical problem can be solved, without much doubt, and with a suitable pulse length, shape and frequency, fish can be influenced in the desired way by pulsed D. C. current with power requirements of only



"FRIGHTENING GEAR" FOR FISH ROUNDUPS. *Like the shepherd's dog or the cowboy's horse, this equipment drives its quarry into smaller areas where it can be caught. The negative electrode is lowered from the stern of the boat (foreground) while the positive electrodes are suspended between the two boats. This gear is most effective in fjords, or in large ponds or gravel pits, where ordinary fishing gear cannot be used.* (Electrical Fishing *by P. F. Meyer-Waarden. Reproduced with the special permission of FAO, United Nations)*

boated easily. Usually after being about 1/20 to 1/100 of steady D. C. or A. C. current.

So we approach feasible power requirements—although we are still far from economic levels.

The Germans are out in front in electrical fishing in the ocean, and every scientific paper or popular article mentions one man as a matter of course. He is Dr. Konrad Kreutzer, German engineer and ex-naval officer. Dr. Kreutzer became interested in the possibility of electrical fishing during World War II. After the war he began to test his ideas. The trials were successful enough initially to encourage him to secure and refit a German mine-sweeper, the R96. One engine of the ship was removed to make way for the electrical equipment, which could deliver impulses of up to 15,000 amperes and from 60 to 300 kilowatts.

Tests with Herring and Cod

Kreutzer's most widely publicized experiments were conducted in the Kiel Förde in April, 1952. Here he showed dramatically that cod and herring, which he had previously captured and released in the electrical field, could be forced to swim to the positive pole. The herring, being smaller, were influenced over a shorter distance than the cod, about 33 feet compared with about 49 feet.

The anode, or positive pole, was a metal plate 25 square feet in surface, suspended about 130 feet away from the vessel by floats. The cathode was a 45 square foot plate fastened to the hull of the R96 near the stern. It should be noted that the salinity in Kiel Förde is only about half that in the open sea, so less power was required for these experiments than would be needed in the ocean.

Similar to Electric Fishes

It is interesting, incidentally, to realize that the characteristics of the voltage impulses discharged by electric fishes, such as electric eels and catfish (described by Dr. Charles E. Lane in the June, 1957, *Sea Frontiers*) are very similar to those produced by the German gear.

Electricity was combined with two other revolutionary ideas for catching fish in an experiment carried out in the United States by the U. S. Fish and Wildlife Service. The exploratory fishing vessel *John N. Cobb,* working out of Seattle, attracted herring and

other small fish with a light, held them in place with electricity, and pumped them into a tank on deck through a hose. The carbon plate anode and the stainless steel wire screen cathode were 10 feet apart and the current used varied from 85 to 170 amps. The light used as an attractant to the fish was 1000 watts.

Drama under Floodlights

Scientists watching the apparatus from the deck could see fish coming up to the light from below, apparently not noticing the electrical field until they were in its influence. Then they turned, in the now familiar manner, and swam toward the anode, where they were caught in the water current and swept into the boat through the hose. When the apparatus was working best a continuous stream of fish stunned by the current flowed into the tanks. The top rate was 1178 fish per minute!

Taking large fish and whales with the force of an electrical current, rather than herding them to a given spot, seems to offer more immediate prospects of success. Tunas, being large fish, are hard to land by hook and line, and sometimes more fish escape than are caught, even after being hooked. For example, Swedish and German fishermen are reported to have lost nine out of ten fish taking the bait under the old method—which is not surprising since these tunas reach a weight of 800 pounds.

Fishing with electricity all fish are boated easily. Usually after being hooked the tuna turns around and swims away from the boat, thereby lying parallel with the line. One electrical pole is in the hook and metal leader, and the other in the line. Electricity is now turned on and the fish is stunned and can easily be pulled aboard. Here it must be dispatched immediately, since it revives quickly. Fewer men can handle more lines with this new method, and greatly increase the catch. Sharks and other large fish can be killed in a similar way on floating long lines.

Whaling is strictly controlled by international conservation agreements, which set quotas on the number of animals which can be caught each year. This has put a premium on speed and efficiency of capture. Electricity could be a boon to whale catching, killing more surely and humanely than the old explosive harpoons. Electrical cables are run down the harpoon lines and a 220 A. C. current is used to electrocute the whale when the harpoon has been set. The whale rises rigid to the surface, and turns on its side. Death takes place in 10-15 seconds, but for safety the current is allowed to flow for three minutes.

Strange Effect of Echo Sounder

Earlier it was suggested that, before harpooning whales, it should be possible to shoot an electrified harpoon over the whale so that the animal was caught in an electrical field and stunned, and then it could be measured and examined to determine if it should be killed. This idea has not been carried out, due to the technical problems.

Another idea which also approaches fantasy is reported to be in operation. Echo sounders have been used for years to locate and track

whales and the sonic beams appear to have a strange effect on the whale. The animal changes its position so that it lies in the longitudinal direction of the beam, in which position it minimizes the discomfort which it apparently feels. The whale can thus be forced to swim in a fixed direction, provided the equipment on the boat is designed and operated in a certain way. This increases the efficiency of the whalers, and a Norwegian fleet has used the system effectively.

Electrical Seine

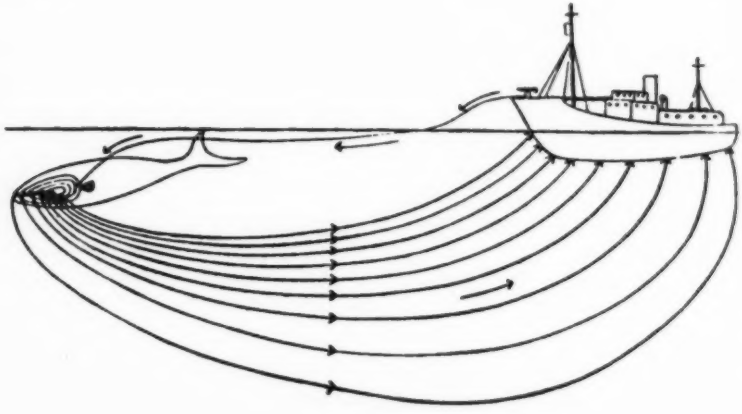
There are many other suggestions as to how electricity might be applied to fishing operations. Some of them seem beyond possibility, but who knows?

An electrical seine has been proposed, for example. This would involve surrounding a school of fish with an electrical cable, so that they would be held in a tight bunch without the benefit of a net. The circumference of the cable would then gradually be made smaller until the fish could be pumped or bailed aboard the boat. The technical problems are formidable, to say the least.

A frequently mentioned possibility is to combine a trawl with an electrical current. Using an ordinary trawl which drags the bottom, catches might be increased by setting up a field between the steel lines that connect the ship to the net. Many fish that ordinarily escape the trawl might be stunned and swept into a net rigged in this way.

If a floating trawl were employed, fishing above the bottom so as to clear rocky or foul bottom, fish could be forced out of their hiding places

THE ELECTRIC WHALE HARPOON IN ACTION. *Arrows indicate the direction of the pulsating current, which paralyzes the whale as soon as the harpoon hits it. The whale is unable to sound and thus escape, and death soon occurs. Use of pulsating currents, which require only a fraction of the energy used in continuous currents, may some day permit offshore whaling from helicopters.* (Electrical Fishing *by P. F. Meyer-Waarden, reproduced with the special permission of FAO, United Nations)*



among the rocks and up within the path of the net. Thousands of square miles of area now unfishable would then be opened for fishing. This was in mind at The Marine Laboratory of the University of Miami in 1952, when experiments were carried on to discover if shrimp could be influenced by electrical currents as are fish. It turned out that they could, flipping madly toward the anode when the current is on, turning and racing to the other end of the tank to the new positive pole when the field was reversed. Power requirements will keep this discovery from being applied very soon, however, and no electrical trawl is over the immediate horizon.

"Telephone" Poachers

Fresh water applications, due to technical advantages, are increasing in number and variety. Electricity is now being used successfully to keep migrating young salmon out of irrigation ditches and out of turbines. Adult salmon are protected from predatory bears by electrically charged fences. Lampreys, which have threatened the whole enormous sport and commercial fishery of the Great Lakes, are being killed by electricity as they move up streams to spawn. In fact, electricity is so successful and easy to use in fresh waters that a current strong enough to make fish jump out of the water can be produced by an old fashioned telephone, encouraging a new type of poacher, who "telephones" fish right into his creel.

Such problems do not yet exist in sea fishing, but conservationists already are worrying about depletion of fish stocks if electrical fishing becomes possible in the ocean. Should we hope that the engineers fail to solve the technical problems that now bar large scale electrical sea fishing, for fear that it would decimate our fish populations? I doubt it. Any efficient gear, used without discrimination, can be dangerous, but efficiency

THESE CRABS WERE REALLY "SHOOK UP." *In Germany, the Chinese crab—originally from China—has become such a pest that electrified cables (Nos. 1 to 3) are stretched across streams when the crabs move in from the North Sea in the spring. Three electrical fields are developed: (A) 1 1/3 inches in width, and (B and C) 4 inches in width. Crabs entering the fields during interruptions of current are either killed, or they throw off their limbs. Thus they cannot continue their migration.* (Electrical Fishing, *by P. F. Meyer-Waarden. Reproduced with the special permission of FAO, United Nations*).

A FOUNTAIN OF FISH. *Once the fish have been concentrated toward one side of the net by means of an electrical current, they can be pumped aboard a vessel in the manner shown here. These are net-collected menhaden, coming aboard a large purse-seiner off the Atlantic coast of the United States. (John Robas)*

as such should not be condemned in fishing any more than in manufacturing shoes.

Conservation of fish stocks can much better be effected by controlling the total catch or the size of fish taken than by prohibiting effective kinds of gear. Electrical currents affect fish of large size more than those of small size, and hence are more adaptable to regulation than many fishing devices, At the same time the total catch made by electrical fishing could be as easily controlled as that of any gear.

What of Sterility?

Since electricity can be lethal to living creatures, and since it has such surprising physiological effects in less-than-lethal quantities, it is reasonable to ask what might happen to the reproductive capacity of fishes subjected to the current produced by an electro-fishing machine. Fish caught in fresh water for hatchery purposes, for example, or fish which are trapped temporarily in an electrical field but which later escape, might conceivably be rendered sterile, or have their germ cells so altered that they produce monsters instead of normal offspring.

Fortunately, all evidence indicates that these fears are groundless. Damage is done to the roe of fish, according to a University of Berlin worker, if the fish comes very near to the positive pole in an electrical field of high intensity. In practice, however, most fish are not subjected to this situation (or if they are they die) and currents produced farther away from the electrode have no measurable effect on the reproductive capacity. Fish caught electrically showed the same spawning behavior and produced the same kind of normal offspring as ordinary fish.

Tests with Bass

Similar conclusions were reached in this country, using large mouth bass as test animals. Eight bass were stunned by 2500 watt, 230 volt A C. apparatus and put in a pond containing no other fish. The pond was drained after 15 months and the original eight bass were found, along with 4288 progeny, two to eight inches in length. Parents and young were all in good condition.

If the quality of the flesh of fish caught by electricity were inferior this would make the method useless. As it turns out, fish caught in this way spoil more slowly than those caught in nets by hooks. This may be related to the smaller production of lactic acid, which forms in the muscles of fish as they struggle to escape standard kinds of fishing gear. They are spared this struggle by the sudden effect of the electrical current.

German Experiments

Will we ever attain the promised marvels of ocean electrical fishing, and if so, how soon? This is hard to predict. In 1954 the R96, Dr. Kreutzer's converted minesweeper, was bought by a big menhaden producer

of Lewes, Delaware, and brought to this country to continue the pioneer experiments started in Germany. No reports of success have come from these tests, but whether this means no success has been achieved or that the canny owners of the boat are not yet willing to share their techniques, is impossible to say.

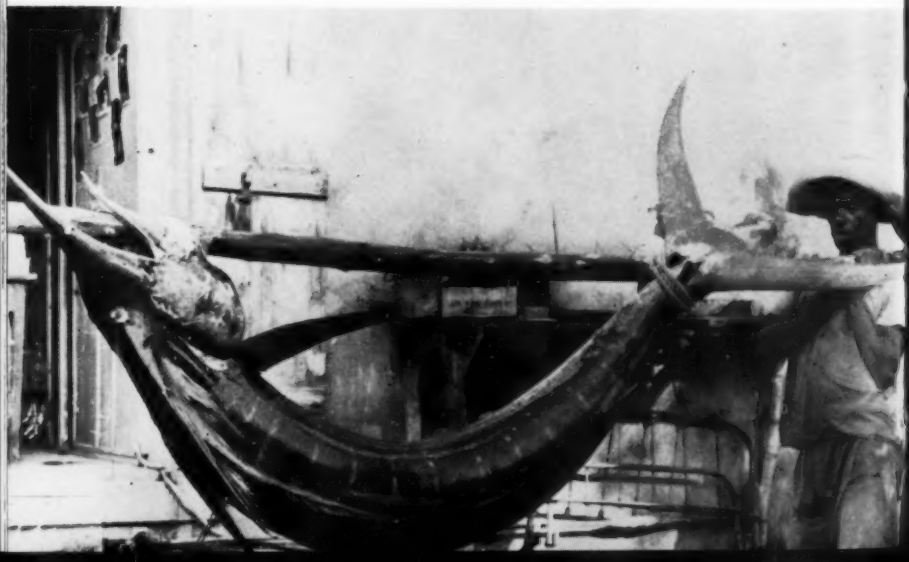
Even when engineers achieve ways of practical production of power to produce results close to those in fresh water, we are reminded that fish can be attracted from only a very short distance under the best conditions. This distance is around 10 or 15 feet, and this is too short to be of practical interest.

The British report, on the basis of experiments by the ship *Silver Cloud*, that a generating plant having a rating of about half that of the main engine is the practical limit of size. They state that fish must be caught in profitable quantities with this much power, or the "commercial prospects of marine fishing become very limited."

Writers who are assessing a potential increase of food from the sea insist that some breakthrough in fishing methods is necessary to raise our present fish production by any worthwhile figure. Electrical fishing is mentioned hopefully as one possible way of achieving this breakthrough. It is a truism that whatever is needed badly enough will eventually be achieved, and it is not at all beyond the realms of possibility that successful, profitable electrical fishing in the ocean will some day be a reality.

Fine Marlin Caught in Antilles

FROM GUADELOUPE, *French West Indies, comes this photograph of a blue marlin, weighing 420 pounds. Guadeloupe's organization of sport fishermen, "The Fishing Club des Antilles," will hold its second fishing tournament at Les Saintes, Guadeloupe, in August. Visiting sports fishermen will be welcome. (Photo from Mr. Ary Ebroin)*



Pathfinder of the Seas

By J. L. McHugh
Virginia Fisheries Laboratory
Gloucester Point, Virginia

"There is a river in the ocean. In the severest droughts it never fails, and in the mightiest floods it never overflows. Its banks and its bottoms are of cold water, while its current is of warm. The Gulf of Mexico is its fountain, and its mouth is in the Arctic Seas. It is the Gulf Stream. There is in the world no other such majestic flow of waters. Its current is more rapid than the Mississippi or the Amazon, and its volume more than a thousand times greater."

THUS Matthew Fontaine Maury, one of Virginia's most distinguished sons, and the founder of scientific oceanography, introduced his monumental work "The Physical Geography of the Sea" in 1855.

Who was this great man, how did he gain his extensive knowledge of the sea, and what does his work mean to us today? Born near Fredericksburg, Virginia, on January 14, 1806, Maury became a midshipman in the U.S. Navy at the age of 19, and cruised around the world from 1826 to 1830.

Two Serious Accidents

Unfortunately for him, but luckily for the world, he suffered two serious accidents during his life. The first, a disastrous fall from a tree at the age of twelve so injured his back that, unable to continue work on his father's farm, he was sent to a private school. Here he received a much better education than country schools of the time provided. The second, a stagecoach accident, in 1839, lamed him for life. While it put an end to his seagoing naval career, the mishap indirectly led to his appointment in 1842 as Superintendent of Charts and Instruments, the forerunner of today's U.S. Naval Observatory and Hydrographic Office.*

In 1834 Maury obtained leave from the Navy, married, and settled in Fredericksburg. Encouraged by publication of his first scientific article "On the Navigation of Cape Horn," he devoted most of the next seven years to writing. His first book "A New Theoretical and Practical Treatise on Navigation," published in 1836, was favorably received and soon replaced Nathaniel Bowditch's "Practical Navigator" as a textbook for junior Naval officers.

Blasts Graft In Navy

Assigned to a projected Naval exploring expedition to the south seas, Maury became frustrated and disgusted with the long series of delays caused by dissension at higher levels. He wrote a series of articles under a pseudonym, criticising inefficiency and graft in the Navy, and pleading for better training of officers.

*See "Oceanography and the Hydrographic Office," Sea Frontiers, March, 1957.

MAURY

IN RICHMOND, A CITY OF MONUMENTS, *one of the finest honors Matthew Fontaine Maury. It was erected in 1927 through contributions from the General Assembly, the school children of the State, and the United Daughters of the Confederacy. The monument depicts Maury listening to the voice of a storm on land and sea, represented by the group of figures supporting the globe. (Robert S. Bailey)*

His reputation so grew as a result of these writings that President Tyler at one time considered appointing him Secretary of the Navy. It was at this stage that he received the appointment, as Superintendent of Charts and Instruments, that was to mark the climax of his career.

Enlists 1,000 Ships

Maury's first work in this new position was to obtain and install instruments for better astronomical observations. Appearance of the first volume of observations in 1846 placed the American Observatory in a class with the best European institutions. His most practical contribution to science, and that which gave him the name "Pathfinder of the Seas," was the preparation of wind and current charts, the first of which were based on information in old log books, discarded by the Navy as useless. He predicted that, by following his directions, mariners might shorten the average 55 days' voyage from New York to Rio de Janeiro by ten to fifteen days.

The barque *W. D. H. C. Wright* of Baltimore fulfilled this prediction admirably by sailing from the Virginia Capes to Rio in 35 days and returning in 40. This voyage aroused interest in his plan for systematic observations at sea, and soon more than 1,000 ships were making observations for him in all oceans. Charts prepared from these observations contained information on wind force and direction, details of trade winds and adjacent calm zones, probable wind direction for each month, surface water temperatures, frequency of storms, rains, fogs and calms, and abundance and kinds of whales at various seasons.

The value of these charts to the shipping industry can be judged by the following excerpt from the introduction to the first edition of "The Physical Geography of the Sea."

"At the meeting of the British Association of 1853, it was stated by a distinguished member . . . that in Bombay, whence he came, it was estimated that this system of research, if extended to the Indian Ocean, and embodied in a set to charts for that sea . . . would produce an annual saving to British commerce, in those waters alone, of one or two millions of dollars; and in all seas, of ten millions."

Aided Clipper Ships

The California Gold Rush, which began in 1849, caused a great increase in shipping from the Atlantic to the Pacific coast of the United States. The famous clipper ships, launched in response to the demand for rapid transportation from one coast of the continent to the other, used Maury's charts to advantage in their races. Sailing time between New York and San Francisco, formerly about 180 days on the average, was reduced con-

siderably. The *Flying Cloud* established a record in the extraordinary time of 89 days, 21 hours.

Maury's dream of a universal system of meteorological observations on land and sea was given impetus at an international conference in Brussels in 1853, which he attended as the U.S. representative. The conference was highly successful, and many nations agreed to cooperate.

Victim of Jealousies

Like other great men of history, Maury's accomplishments were not fully recognized at home. Though he received official praise more than once from various Secretaries of the Navy, he still held the rank of Lieutenant as late as 1855. In that year Congress passed an Act to "promote the efficiency of the Navy." The board of Naval officers assembled under this Act placed Maury's name, among others, on the "reserved list" with leave-of-absence pay, and neither explanation nor opportunity for redress was allowed.

Honors from Abroad

Thus did his fellow officers give vent to hostility and petty jealousy, generated no doubt by his professional successes, his exemption from sea duty (though he had repeatedly requested to go to sea), and his own efforts in support of Naval reorganization. Repeated protests, not only by Maury, but by influential members of the press and other supporters, led eventually to amendment of the Act, and a court of inquiry was convened to consider his appeal.

The findings of this court, and public sympathy aroused all over the country, persuaded President Pierce to restore him to the active service list and promote him to the rank of Commander. Thus, almost three years after passage of the Act, he was vindicated. Meanwhile, though his own country had not only failed to recognize his accomplishments but also had submitted him to humiliation, honors had been heaped upon him by most of the leading governments of Europe.

Although his sympathies lay with the South, Maury tried to conciliate and mediate the conflict between the States that was brewing in the 1850's. But, when Virginia seceded from the Union in 1861, he resigned his commission in the Navy, heartsick in the knowledge that this would end his scientific life. From the very beginning of the War he was an object of condemnation from the North. In 1864 the National Academy of Sciences went so far as to pass a resolution stating that his sailing directions and wind and current charts were unsound and useless, and should no longer be issued.

Having been commissioned in the Navy of the Confederate States, Maury played a leading role in the southern cause. He assisted in fortifying Jamestown Island in the James River and Gloucester Point on the York, and served on the Executive

THIS STRIKING PAINTING *of the "Pathfinder of the Seas," by E. Sophonisba Hergesheimer, hangs over the entrance to Maury Hall, U.S. Naval Academy, Annapolis. It was presented in 1923 by the Atlanta Chapter of the United Daughters of the Confederacy. (Courtesy of The Mariners Museum, Newport News, Virginia)*

THE RESEARCH VESSEL *of the Chesapeake Bay Institute of The Johns Hopkins University is named for Matthew Fontaine Maury, famous oceanographer. She was built in 1950 to conduct physical and chemical investigations of Chesapeake Bay and its estuaries. Her operations are financed jointly by the states of Virginia and Maryland and by the Office of Naval Research. (Chesapeake Bay Institute)*

Council of Virginia. He developed a submarine electrical mine and conducted successful trials in the James River in 1861.

Later he urged expansion of the Navy, and pleaded the merits of "big guns and little ships" so successfully that construction of up to a hundred small gunboats was authorized and begun. But meanwhile, the initial successes of the *Merrimac* so demonstrated the value of armor-plated vessels that construction of the gunboats was halted.

Through this development and other incidents Maury lost faith in Navy Secretary Mallory and President Davis, and his opinions and writings in turn caused Mallory to curtail his activities and influence. Eventually, late in 1862, he was sent to England on "special service."

Electric Mine Experiments

In England he secured ships for the Confederacy, and sympathy and support for her cause. Maury also conducted extensive but unsuccessful political intrigues with Emperor Napoleon of France and Maximilian of Austria, designed to bring about European intervention in the War. A fourth activity was a continuation of his experiments with electric mines. It was while he was returning to Virginia in 1865 that he learned of the collapse of the Confederacy. Advised not to return to the United States, he remained in the West Indies, and from there went to Mexico to serve under Maximilian, who was just beginning

his ambitious plan to colonize that country.

Maury left his family in the United States when he went to Europe in 1862. Early in 1866 arrangements were completed to rejoin them in England. Once there, forced to earn money to support them, he carried on his work with mines, and later was engaged by a New York publishing house to write a series of school geographies.

Professor at V.M.I.

In 1868 he returned to the United States to accept the chair of astronomy at Virginia Military Institute. He occupied himself with writing and lecturing, and devoted considerable effort to a campaign in support of a universal system of telegraphic meteorological observations and crop reports. Strangely enough, this scheme, now considered a weather bureau necessity, was dismissed at that time as visionary and impractical. He took ill during a lecturing tour in St. Louis in October 1872, and died in February 1873. Maury was buried in Richmond, between the tombs of ex-Presidents Monroe and Tyler.

It was only after his death that anything approaching proper recognition came to Maury from his native country. Many honors had been bestowed upon him from abroad, and he numbered among his close friends many Europeans of noble birth. Even now, his name is surprisingly unfamiliar outside his native State, the U. S. Naval Acadamy, Annapolis, Md., and a few other maritime institutions. The rising importance of the oceans and rapidly increasing scientific and popular interest in marine resources may yet elevate this great American to his proper place in history.

For Further Reading:

Matthew Fontaine Maury, The Pathfinder of the Seas, by Charles Lee Lewis, 1927. United States Naval Institute, Annapolis, Md. xvii - 264 pp.

The Physical Geography of the Sea, by M. F. Maury, 1855. Harper and Brothers, New York. 274 pp., 12 plates.

Neptune Post Office

KEEP YOUR EYES OPEN for bottles containing messages, particularly if they have corrosion-proof plastic caps. Return of the messages to the Seaman's Church Institute of New York will bring you a seascape in oil, or a ship model. The bottles recently were dropped from the *United States* on a regular voyage to England. Of some 450 bottled notes tossed from the same liner two years ago, two drifted ashore in France.

In 1957, 360 bottles were tossed from the Farrell liner *African Lightning* between the Virgin Islands and the French West African Coast. While none of these have been recovered, oceanographers will continue to follow such activities. If finds are accurately recorded, the bottles can give clues to new oceanic currents or variations in old.

RESULTS OF A REMARKABLE DAY'S CATCH—*22 big-eye tuna and 15 sharks. Taken ten miles off Cabo Blanco on 22 baskets of longline gear (330 hooks), this catch may be the highest recorded per hundred hooks for big-eye. A fisherman holds a typical basket of gear. (D. H. Bates, Jr.)*

They're Found Deep

By D. H. BATES, JR.

THERE'S A NEW THRILL awaiting the sportsman who explores the ocean depths with rod and reel. What could be more exciting and challenging than trying for a game species that most fishermen have bypassed for years simply because they neither realized this fish existed nor the possibilities of catching it? That's exactly what the depths are yielding, another species which the writer feels has not been given its fair share of credit as one of the Pacific's great, but unheralded game fish.

Big-Eye Tuna

The fish is the big-eye tuna, *Parathunnus sibi* or *mebachi* to be more correct, and its most frequented habitat is none other than Cabo Blanco, Peru, world famous for the black marlin but also blessed with this lesser-known fighter. Sure, big-eye have

been taken many times by sportsmen off Cabo Blanco but, until recently, no one had any idea as to the real potential of the resource that this fish represents in northern Peruvian waters.

The big-eye lives deep. As a matter of fact, it is seldom taken or seen on the surface. This is what gives Cabo Blanco a great one-two punch—surface trolling for blacks and deep drifting for big-eye. The big-eye have been hauled from 300 fathoms in some areas of the world, just to give you some idea of their pressure limit. But you need not try below 70 fathoms to strike the heart of their habitat. Thirty fathoms is about the upper limit of their regular travel lanes and 50 fathoms would be a good average.

THIS BIG-EYE TUNA *weighed 367 pounds, more than three times the weight of Serafin Martinez, the Peruvian fisherman easing it over the rail. The big fish was taken four miles off the coast of Peru, between Los Organos and Cabo Blanco. (D. H. Bates, Jr.)*

How to Tell a Big-Eye

How do you recognize the big-eye? At first glance, it looks just like a yellowfin. The distinguishing of this species as against a yellowfin is probably as tough as any a sportsman will have to make. Don't conclude that if it is caught deep, it must be a big-eye. Actually, in certain Pacific areas, five to seven times more yellowfin than big-eye are raised from the depths. Look at the fish carefully. First you will notice that the big-eye is a chubby fellow, fat through the belly and much stouter than the yellowfin. Its head and eyes are proportionately larger although this is not readily discernible without comparative measurement. It has large scales, more pronounced than on the yellowfin, and there is an almost total absence of white belly spots. A good characteristic that the writer recommends is the thick black border on the trailing edge of the finlets of a big-eye as compared to the faint black tinge on yellowfin finlets. The second dorsal and anal fins are always short which definitely rules out the possibility that the fish could be an Allison tuna. If all the external characteristics fail and there is still some doubt, the only recourse is to dissect the fish and examine the liver. The big-eye has marginal striations on the ventral surface which are not found in the yellowfin.

Two Hundred Pounders

You can generally expect that all the big-eye will be large. They average 160-180 pounds in Hawaiian waters and better than 200 pounds off Peru. The largest big-eye the writ-

A TYPICAL PERUVIAN FISHING BOAT *being launched through the surf at Mancora, northern Peru. This vessel may be used for shrimping and, equipped with a "pulpit" for observing broad reaches of water, be employed for swordfishing during the season. The Pacific Ocean off Peru is particularly rich in large game fish, including the big-eye tuna, yellowfin tuna, etc. (D. H. Bates, Jr.)*

er has heard of was reportedly more than 600 pounds in weight and was harpooned by a sailboat fisherman off Mancora, Peru. This giant was landed, photographed and then eaten by nearly half of the fishing village population.

As already mentioned, for the sportsman to catch the big-eye, he must revert to drift fishing although trolling will work on those infrequent occasions when big-eye rise to the surface. A sea anchor would help on a windy day. Baiting is easy. A whole sardine, mullet, mackerel, flying fish, or similar bait will work equally as well and it need not be over six inches in length. The big-eye swallows the bait on the first try and, from observations of hooked fish, it may be said that the big-eye always takes the bait in the same manner, hitting while on a horizontal course and lodging the hook on the inside corner of the lower jawbone. This bone never gives way and the writer has never seen a big-eye lost, once hooked, unless the gear itself has parted.

Giant Squid Interpose

Drift fishing for big-eye has its peculiarities and problems. The competition for bait in the depths is a keen one, particularly off Cabo Blanco. When the giant squid are around, you might just as well forget the big-eye. These phantoms of the deep, literally present by the tens of thousands at times, will tear into anything lowered in their vicinity. They are the best bait robbers of all but, to the uninitiated, are good for a rather interesting diversion. While not classed

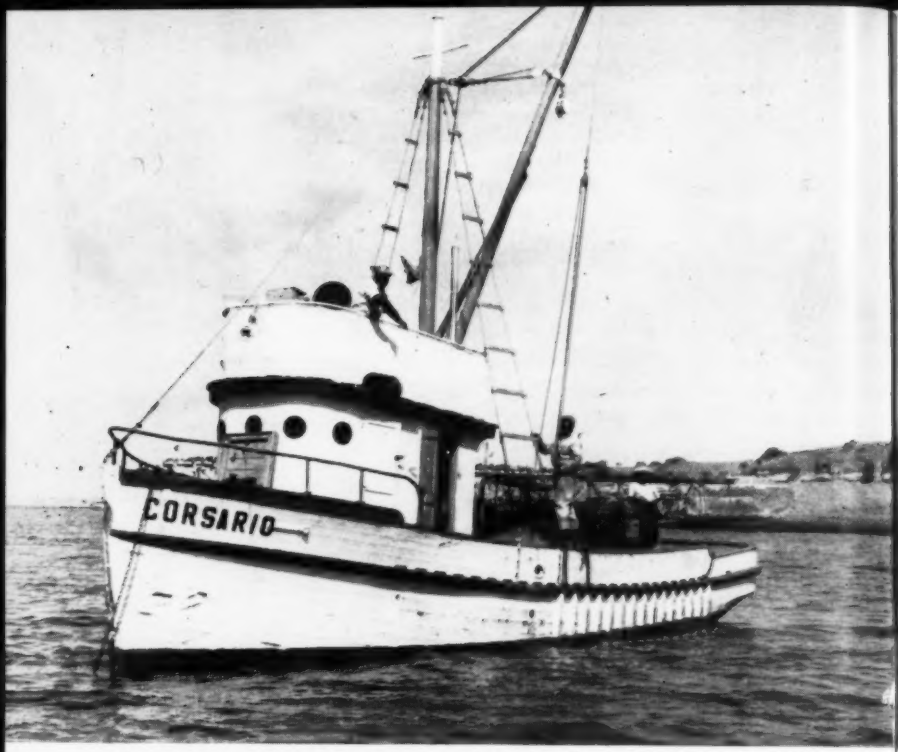
as game, they can put up quite a tussle just the same. Averaging 40 to 60 pounds and 5 feet in length, many larger specimens have been sighted that must have been several times this size. They're dangerous! Bring one to the surface and it may squirt a stream of water and ink of such force as to bowl a man over. And if one of those tentacles grabs ahold, you will be in for a little bloodletting, for within each suction cup is a circular row of bone-like structures resembling teeth which can rip flesh wide open.

Sharks off Cabo Blanco are a surprisingly minor problem to the drift fisherman. Although more than a dozen species have been taken, statistics show that the chances of taking a big-eye as compared to a shark are at least 3 to 1. Striped marlin may be hooked occasionally by the drift method and, of course, yellowfin, bonito, skipjack, sailfish, and dolphin, but the writer, in more than a year's experimental fishing in this area, did not encounter a single subsurface black marlin.

Peruvian Future

Drift fishing is nothing but a condensed version of long-lining, the system used so successfully by the Japanese to exploit subsurface resources of the Pacific. By the long-lining method, the writer was able to sample the

OVER THE RAIL *comes a shark, its ugly jaws snapping. The balsa raft in the background serves as an efficient fishing platform, as well as the only transportation to and from the beach. Sharks off Cabo Blanco are a surprisingly minor problem to the drift fisherman, although more than a dozen species of sharks have been taken in the area. (D. H. Bates, Jr.)*



THE FORTY-FIVE FOOT CORSARIO *is another familiar type of Peruvian fishing craft. Equipped with a small seine winch for hauling gear, it has been used also as an experimental longliner in these deep Pacific waters. (D. H. Bates, Jr.)*

Cabo Blanco waters and gather statistics which otherwise would have required years of effort by sports fishermen. As the sport and commercial methods are entirely analagous in this case, the findings are applicable to both. There is no doubt that northern Peru represents the best and most unexploited fishing ground for big-eyed tunas, given an even break with the giant squid. For those with the sporting blood, here is a new challenge. Some time when you are out there surface trolling and fishing gets a little slow, just remember, they're found deep.

New Research Stimulus

By F. G. WALTON SMITH
Vice President, International Oceanographic Foundation

A NEW stimulus to the development of oceanography in the United States is confidently expected as a result of the activities of a national Committee on Oceanography, recently set up.

The impressive rate at which Russian oceanography has been growing, and the number of large research vessels used by Soviet scientists, serves to underline the need for such a group to encourage and assist marine science in the western world for years to come.

Has Strong Backing

This promising step was initiated by the National Academy of Sciences National Research Council, and it has the backing of the Office of Naval Research, the Atomic Energy Commission and the U. S. Fish and Wildlife Service. Cooperating, too, are the leading research institutions of the country, the Hydrographic Office and other divisions of the Navy, and the National Science Foundation. Its membership includes several of the country's leading scientists and administrators.

Since it was organized in November, 1957, the Committee on Oceanography has held three meetings: Washington, D.C., in January; La Jolla, California, in February; and Miami, Florida, in March. In general, future meetings will be held at institutions which have an interest in marine sciences.

An Extensive Program

The necessity for such a group, devoted to long-range planning in all phases of oceanography, has long been recognized. The new Committee's work will deal not only with the more familiar aspects of physical oceanography, but also with chemical and biological oceanography. In simpler terms, it will be concerned with the waters of the sea, with currents, with living organisms and other materials in the sea and also with the ground under and the air above the oceans of the world.

Two marked trends in marine research accentuate the need for the advisory and integrating functions of such a committee. One is the increasing complexity and interdependence of the various sciences involved, while the other is the greatly increased proportion of research financing that comes from government sources. To ensure maximum usefulness in allocating such funds, while at the same time allowing the greatest possible degree of individual initiative and scientific freedom in research, calls for the highest degree of understanding at top government level. This, presumably, the Committee will attempt to promote through its advice and influence.

"SMILE WHEN I SAY 'OCEANOGRAPHY,'" *requested the cameraman, and the oceanographers did. Members of the staff of the Marine Laboratory, University of Miami, join the Committee on Oceanography for a group photograph during an interval between sessions held in Miami, Florida, in March. Previous meetings of the Committee took place in La Jolla, Calif., and Washington, D. C. (Edmond Fisher)*

Chairman of the group is Harrison Brown, of the California Institute of Technology. Other members are: Maurice Ewing, Lamont Geological Observatory; Columbus O'D. Iselin, Woods Hole Oceanographic Institution; Fritz Koczy, Marine Laboratory, University of Miami; Sumner Pike, former Commissioner of the Atomic Energy Commission; Colin Pittendrigh, Princeton University; Roger Revelle, Scripps Institution of Oceanography; Gordon Riley, Bingham Oceanographic Laboratory, Yale University; Milner Schaefer, Inter-American Tropical Tuna Commission; and Athelstan Spilhaus, Minnesota Institute of Technology.

Six Panels Named

In order to simplify the Committee's studies, six panels have been formed to examine particular problems, including new research ships, new devices for exploring the ocean, radioactive waste disposal at sea, international cooperation in the marine

sciences, ocean resources, and basic research in the marine sciences. The panels are under the chairmanship of members of the Committee, with additional distinguished scientists, including Allyn Vine, Robert Snider and Alfred Redfield.

In addition to the specific programs undertaken by the panels, the Committee as a whole hopes to: (1) make recommendations concerning our long-range national policy on oceanography; (2) assist in all possible ways to increase both the quantity and quality of basic research in the marine sciences; and (3) advise government agencies in problems involving the marine sciences.

A preliminary report of the Committee's initial meetings and the progress being made by the panels is being prepared for release later in the year. Marine scientists and the public will be kept informed of any outstanding developments. The Committee has also announced that it would welcome comments and suggestions from anyone interested in oceanography and the marine sciences.

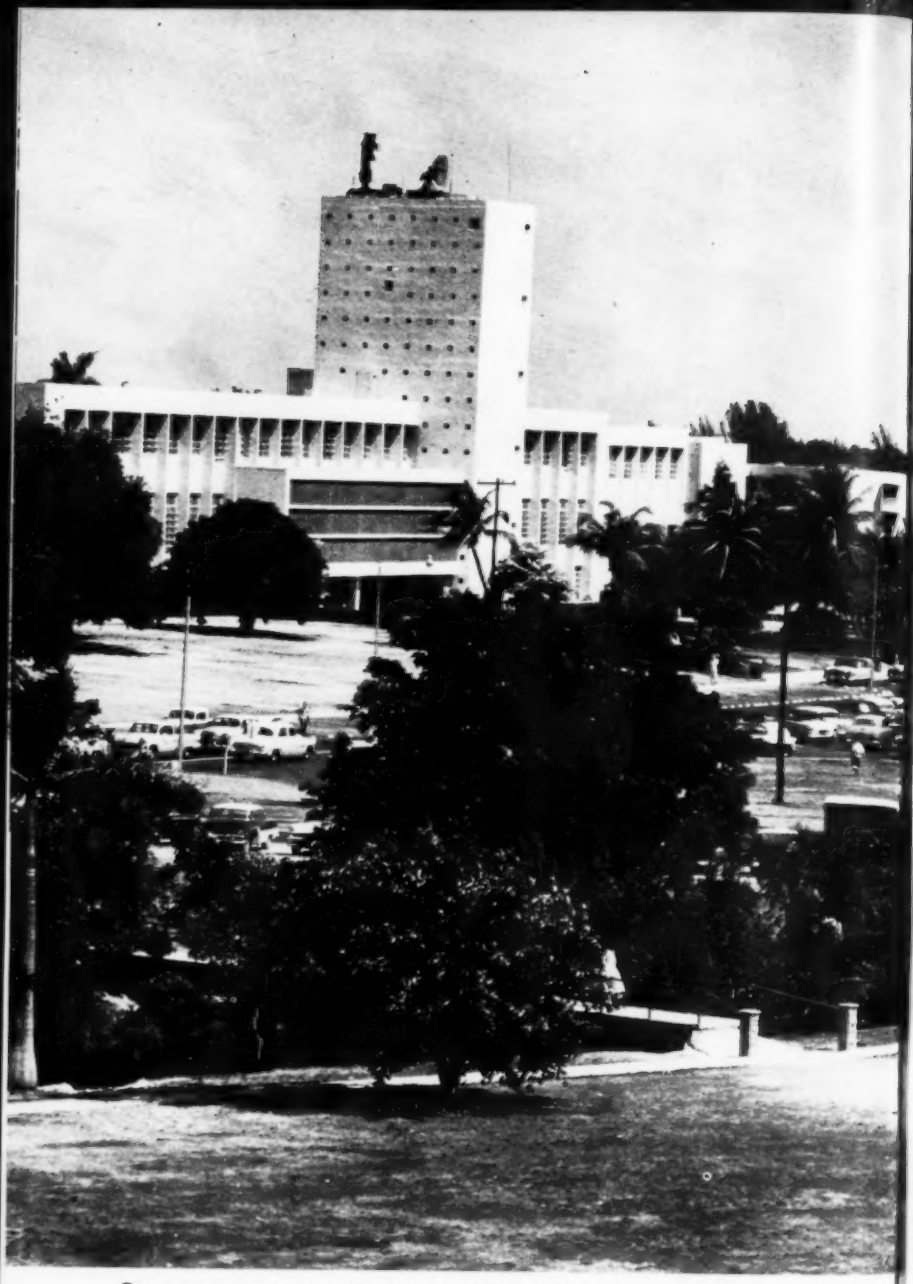
It is to be hoped that this increased responsibility on the part of government towards the progress of marine science will not diminish the feeling of responsibility on the part of industry and of individual members of the public. The entire nation, indeed the entire world, benefits from the basic research carried out by marine scientists. Most of their discoveries may not be immediately applicable to industry or warfare, but in the long run there are nc useful applications that are not the results of basic science.

Stagnant "Pool" Found In Caribbean

MOST WATERS of the open seas are in constant circulation. Stagnant water is known to occur only in certain fjords and in the Black Sea. Recently, however, oceanographers cruising the Caribbean found a pool of stagnant water, 4,680 feet deep, off the coast of Venezuela. Called the Cariaco Trench, this great underwater valley is shut off from the rest of the sea by a sill which permits no other ocean water to enter from depths greater than about 500 feet.

The trench is more than a mere curiosity. Some scientists hold that petroleum may have been laid down under anaerobic or oxygen deficient conditions similar to those that exist in the trench. Organic material, sinking from surface waters, is decomposed by bacteria, thus depositing a layer of organic material on the bottom of the trench, and releasing inorganic compounds. These cannot return to the surface to aid plant growth. Higher forms of life cannot exist at all in this stagnant water.

Scientists of the Woods Hole Oceanographic Institution, aboard the research ship *Atlantis,* are studying this strange formation, collecting cores of bottom sediments, taking water samples at various depths, and making a continuous profile of the ocean-bottom contours with a precision echo sounder recorder.



ONE OF A NETWORK OF "LISTENING POSTS" *is located at the University of Miami, Coral Gables, Florida. Radars on top of the Merrick Building are used by scientists of the University's Marine Laboratory to help pinpoint storms far at sea. (University of Miami)*

Tracking Hurricanes At Sea

By H. V. SENN

AS RECENTLY as fifty years ago the only information on a hurricane at sea came from luckless ships caught in one, provided they managed to escape to tell about it. Until widespread shipboard use of the wireless, any kind of a tropical storm warning was limited to the first hand information the forecasters and public gained from the winds, clouds and barometric tendencies of the fringe areas of the storm itself.

After it had hit coastal areas, the path of a hurricane's destruction was plain enough, although the storm's intensity usually diminished rapidly. The finding and tracking of hurricanes over the oceans at that time presented almost insurmountable problems, but everyone recognized that this was the only key to adequate warnings.

Until World War II, progress in obtaining data at sea was limited to reports received from a few ships in or near a storm. These messages often contributed enough information to the synoptic weather map to indicate existence of a storm to the alert forecaster.

War Brought Aid

With the advent of the war, the number of ships and planes over the oceans doubled and redoubled, and the probability of accurate detection began to rise. It was then discovered that well-built military planes could withstand the buffeting and turbulence of hurricane winds, and the field of aircraft reconnaissance of the weather was extended to include hurricanes.

As the art of detecting and tracking military objectives with radar was perfected during the war, it was discovered that certain weather phenomenon also returned echoes of radio signals, often obscuring the military targets. Most radar data at the time was highly classified and the science of tracking weather got off to a very slow start. The presence of signals caused by weather on the radar scope interfered with its military or navigational use. For this reason, devices were often employed to actually reduce or eliminate the amount of signal returned by weather, in favor of that from military targets.

Military Radars Converted

As the war ended, it became evident that radars could be built to detect rain falling in the air, and research began on modification of existing surplus military radars for such use. It was found that an efficient radar could increase the forecasters' area of observation from a visual 500 square miles under ideal conditions to 30,000 square miles or more with radar under almost any weather conditions.

In 1945 one of the first observations of a hurricane was made with an Army Air Force radar at Orlando, Florida. Soon radars were installed in military planes, which made increasingly numerous flights into the center of hurricanes. Size and weight restric-

HURRICANE STALKER. *After a tropical storm has been found and penetrated by low-level planes, one of the Navy's "Flying Weather Laboratories," a Lockheed Constellation with special radar domes, can sit just outside of the wind's fury and track the storm for up to 24 hours per flight. (U. S. Navy)*

tions imposed on airborne radars left them rather inefficient, as compared with land based radars, and this, combined with aircraft navigational errors, left much to be desired in the center position data obtained.

Landmarks 500 Miles Away

However, recent years have shown great advancement in hurricane tracking techniques, in the radars used, the navigational accuracies achieved, and in the methods employed. Radars now are capable of ranges of 200-300 miles in all directions from the aircraft, and wave lengths up to 10 cm are being used to reduce the weakening of signal due to intervening precipitation.

New navigational aids enable the crew to locate the plane, and therefore the storm, more accurately. It is now possible to photograph the radarscope with recognizable landmarks 300-500 miles from the storm, thereby pinpointing the positions of plane and storm center.

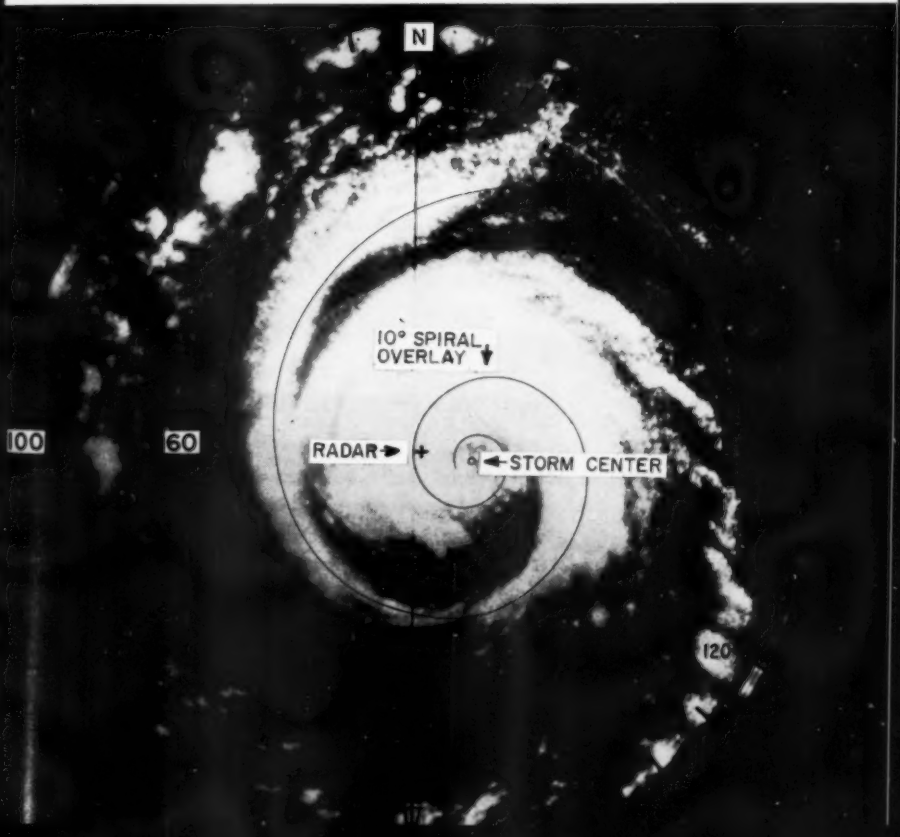
The ultimate would seem to have been accomplished in tracking hurricanes, but nature rarely duplicates the exact conditions of one storm in the formation of another. Some storms are almost impossible to track accurately because of either insufficient or overabundant radar return. In the first case it may be because the storm is "dry," with little rain to give a return signal to the radar. In the second case the eye of the storm may be com-

pletely obscured by excessive rainfall or a confused echo area.

In either case the precise storm center is very difficult to estimate. In other instances, hurricanes have had two or more "eyes" so that the correct one, if indeed a single one could have served correctly at all, was impossible to determine for accurate storm tracking.

The illustration on this page shows the precipitation or rain bands (white areas) of a typical storm and how they spiral toward the storm center. The thin white circles are range circles, representing the distance from the radar in 20 nautical mile increments. After studying the relationship between hundreds of these "spiral bands" to the center of the storm, scientists at the Marine Laboratory of the University of Miami working un-

A SIGNIFICANT ADVANCE IN HURRICANE TRACKING. *After studying the relationship between hundreds of "spiral bands" to the center of a hurricane, scientists of the Marine Laboratory, University of Miami, working under U. S. Weather Bureau contracts, have devised a set of three logarithmic spiral templates which can be placed over the bands on the radarscope to indicate the exact position of the center of the storm. This photograph shows such an overlay on the radarscope of "Hurricane Easy," September 21, 1948. (U. S. Navy and Marine Laboratory, University of Miami)*



IN WASHINGTON, D. C., *the data obtained by Navy and Air Force planes, and by many ground stations, is collected and charted so that trained meteorologists may make their predictions of storm intensity and possible future course—information that can save thousands of lives. As in so many other areas of research, more continuous and complete data on sea surface temperatures would greatly advance our knowledge and ability to predict the time and areas of hurricane formation. (U. S. Air Force)*

der U. S. Weather Bureau contracts, have devised a set of three logarithmic spiral templates which can be placed over the bands on the radarscope to indicate the position of the center of the storm, in most cases when the storm center is not easily discernible.

The thin black line on the radarscope shows how these overlays can locate the storm center even when the eye, though void of precipitation, is obscured by signals returned from ground clutter near the radar site. This represents another step forward in the accurate art of tracking hurricanes with radar at sea, even when conditions are less than ideal.

Spawning Grounds

Research on all phases of the hurricane problem is continuing at the National Hurricane Research Operations Base at West Palm Beach, Florida, at other Weather Bureau offices and at military and non-military institutions. It is now widely believed that the hurricanes of the North Atlantic, Gulf, and Caribbean, and the typhoons of the Pacific Oceans all require large areas of warm seas for spawning grounds. Weather Bureau

researchers in Miami have found evidence that both the path and intensity of the storm may be affected by the surface temperatures of the sea over which it moves.

Most ships are equipped with thermometers which constantly measure the temperature of the sea, but these measurements are not taken exactly at the surface. Such records are hard to obtain on an operational basis. It is now possible to obtain the ocean surface temperatures accurately and quickly by means of net radiometers carried by aircraft. These instruments measure the temperature as a function of the heat radiated by the water surface; but such instruments are carried by very few research aircraft over comparatively little of the ocean's surface.

As in so many other areas of research in meteorology and oceanography, more continuous and complete data on sea surface temperatures would greatly advance our knowledge and ability to predict the time and areas of hurricane formation. Such data may also provide forecast information as to the hurricane's intensity, speed of movement, and the path it will take as it wanders across broad expanses of the sea.

As more is learned about these storms, scientists are beginning to consider the possibilities of steering them along paths which avoid land areas, or perhaps artificially weakening or dissipating their energy in early stages of development by the use of cloud-seeding or other techniques. Those objectives may not be accomplished for many years because of the extreme magnitude of the forces and areas involved.

However, the vast oceans are quickly losing their dark corners where hurricanes might live undetected or uncharted, and eventually hit unwary coastal regions without warning. Increasingly accurate and efficient aircraft reconnaissance and radar tracking techniques devised as part of an overall program are all aimed at better forecasting and warning of storm dangers.

Unique Fisheries Economics Course

DR. RICHARD KAHN, of the staff of The Marine Laboratory of the University of Miami, now has the title of Professor of Fishery Economics—the first such position created in this hemisphere as far as records show. The position recognizes the importance of economics in the fishing industry, acknowledging that fisheries require economic as well as biological and technological research. Because Fishery Economics has not been recognized as a separate profession, Dr. Kahn is also preparing a textbook and other teaching devices, which will be used later to teach students in the Department of Marine Sciences at the University.

WHILE NATURAL EROSION *is taking away many acres of Florida's beaches, man-made fills, such as that shown above near St. Petersburg, not only shorten the general coastline but eliminate shallow-water feeding grounds needed by small fish. Such tiny fry are the food of larger fishes, so a cycle is broken, and large fish prized by anglers may leave the area. Bulldozer (foreground), scoop crane, and suction dredge (center background) can in a few days alter a tidal area as completely as can wind and wave action on outer beaches. (E. John Long)*

Longest Coastline Evaporating?

FLORIDA is a fortunate place for those interested in marine biology and other phases of oceanography because, with 1,277 miles of general coastline, it has the longest seacoast of any state in the U.S.A. Of this shoreline, some 778 miles are open or sandy beaches, ideal for research where sea and land meet.

The situation, however, is not static, partly due to man's doings. At a recent meeting of conservationists, held in Gainesville, Fla., it was pointed out that an average of 300 acres of beach is lost each year from erosion, and scarcely a section of the Florida coastline has escaped the ravages of wind and tide, or the shifting of currents due to extensive filling in of tidal waters or the construction of solid land causeways.

In 1931, the Florida Legislature

authorized study and action to curb beach erosion, but it was not fully implemented until the 1957 legislature appropriated the necessary funds. Under the sponsorship of the University of Florida, a large wave tank has been built in Gainesville to simulate the destructive action of wind and tide on beaches. The project is headed by Dr. Per Brunn, who conducted beach erosion work in his native Denmark. Findings will be of interest to other states and countries having beach erosion problems.

New Oceanic Observations

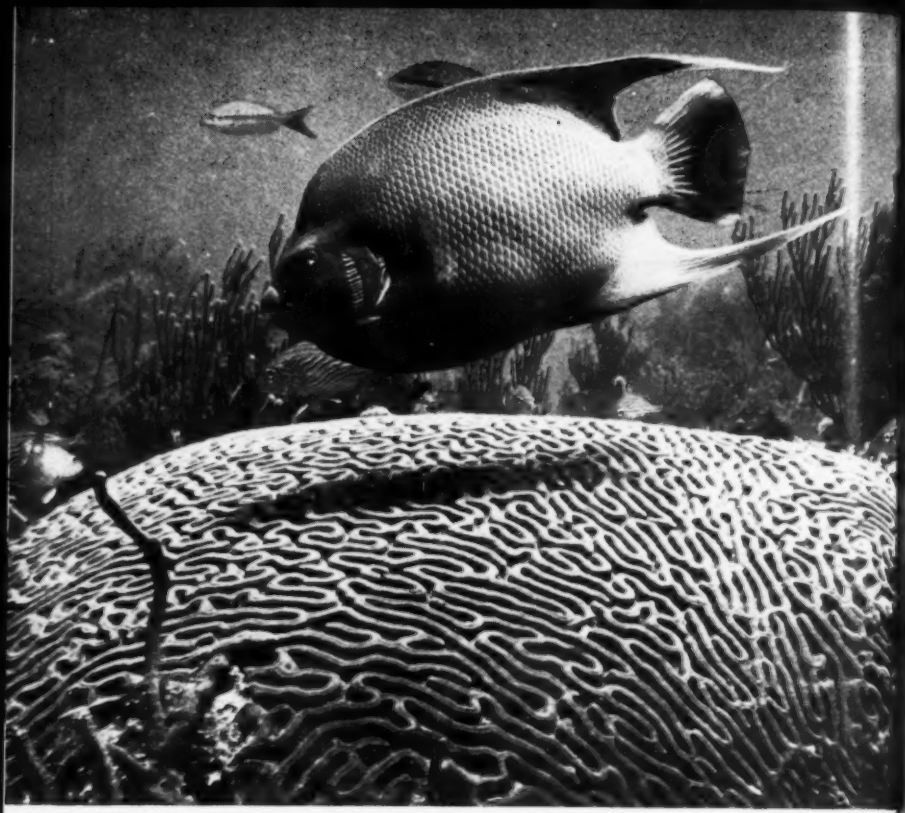
THE International Geophysical Year continues to produce "dividends" for scientists in many fields, including oceanography. The latter will benefit from two newly established observatories in Iceland, near Reykjavik. A tide gauge has been installed by personnel from Lamont Geological Observatory, with the assistance of Icelandic scientists, at the little fishing port of Grindavik. A pier at Thorlakshofn is now being used for short-period and long-period wave meters. The short-period recorder responds to waves of periods between 4 and 20 seconds; the long-period meter to periods of 1,000 seconds.

Although there are about 500 tide gauges in operation throughout the world, there are many gaps, and few gauges are on islands. Hence the importance of the two new stations, which form a part of IGY's Island Observatory Program. Eventually there will be about 200 to 250 new island stations, with location preference being given to islands in the central oceanic areas.

They Know Their Eggs

HUNGRY PREDATORS avoid even the eggs of the Scorpion Fish (*Scorpaenichthys marmoratus*) according to a recent report by R. W. Pillsbury, of the University of British Columbia, in "Copeia." Close observation was made of egg masses along a British Columbia reef. Although the eggs were clearly visible above the low tide line, and the reef and island were roosting places for glaucous-winged gulls, northwest crows, and Baird's cormorants, and also were frequented by ravens, mink and raccoons, all notorious scavengers, the eggs were untouched by any of them. How do they know these eggs are poisonous?

Obviously they are recognized as *not* being food, yet they are bright, and have about the same color range as the red urchin. Perhaps they have an odor, not perceptible to humans, that repels even predators. The author admits he is puzzled, for he concludes his report: "Is this true avoidance, and if so, how was it developed?"



TODAY, WITH THE AID *of a diving lung and an underwater camera, almost anyone can become an explorer of the last earth-bound frontier, the depths of the sea. Here an angelfish hovers over a brain coral, amid the fantastic setting of a tropical reef. (Jerry Greenberg)*

Science of the Sea in Books

Books for the general reader are indicated thus, **(Gen.)**; those of interest chiefly to professional scientists, **(Pro.)**

UNDERWATER PHOTOGRAPHY SIMPLIFIED (enlarged and revised edition) **(Gen.)**

JERRY GREENBERG. Seahawk Products. Coral Gables, Florida, 1958. 46 pages and numerous black and white illustrations. $2.00.

The title should read "Underwater Still Photography Simplified," for motion picture photography is not discussed. If the reader is able to overlook the frequent mention of Seahawk Products, he will find Mr. Greenberg's booklet enjoyable and full of valuable information on undersea photography. The neophyte will profit immensely if he follows the many suggestions to beginners before he takes his camera into Neptune's realm. Some sections, such as discussion of film types and exposure charts, will be useful to experienced underwater photographers as well.

The booklet is profusely illustrated

with exceptionally fine underwater photographs. Of special merit are a series of shots which depict frequent mistakes of beginners. The effect is lessened, however, by the use of the same photo to portray three different errors — making it obvious that all were produced by darkroom manipulation. Curiously, the photograph used to demonstrate the effect of subject *movement* shows one of the slowest of fishes, the bizarre file fish, *Alutera scripta!* Too many of the photos are captioned with data such as the type of camera housing used (invariably Seahawk Mark I or II) rather than information concerning the kinds of fishes or other marine organisms, location, and depth, which would better satisfy inquiries that come to the viewer's mind. The text suffers from being repetitious, both in phraseology and subject matter. But the illustrations more than make up for such shortcomings. Indeed, they alone are worth the price of the booklet.

J.E.R.

GLACIAL AND PLEISTOCENE GEOLOGY. **(Pro.)**

RICHARD FOSTER FLINT. John Wiley and Sons. New York, 1957. 553 pp. This book, not for the general reader, is a sound scientific text. Although based on the previous "Glacial Geology and the Pleistocene Epoch," which appeared ten years ago, it is largely new. Rewriting, rather than revision, was made necessary by the tremendous advances in Pleistocene science during the last ten years, especially in the fields of glaciology, dating, and submarine sedimentation and stratigraphy. Every chapter has been considerably amplified and several new chapters have been added. The number of pages has been somewhat reduced, but somewhat different topographical style and the abundant usage of tables has permitted the author to include a truly remarkable amount of information.

This book, like its predecessor, is destined to be the standard textbook and reference book in its field. It may be divided into three parts: ice and glaciers, ground phenomena, and stratigraphy. The subject matter is treated with the usual thoroughness and clarity characteristic of the author's works. The treatment is fully up to date and papers as recent as 1956 are covered. The bibliography includes about 900 titles, and the illustrations are numerous and well chosen.

Inevitably while reading a book of this type, topics are encountered for which ampler treatment is felt desirable. Such topics, in the present case, may include physics and chemistry of ice, cave stratigraphy, Mediterranean sea levels, African lakes, and the stratigraphy of the marine sediments of Italy, northwestern Europe, and California.

The only inadequate portion of the book is the topical index, from which many names have been omitted. Were these included, the practical value of the book would have been even greater. Prof. Flint's book nevertheless is a must for all geological libraries, including personal ones.

C.E.

About The Authors

DR. C. P. IDYLL

Clare Idyll was born in Edmonton, Alberta, deep in the northern Canadian prairies. Being a dull boy, he confesses, it took eight years for him to realize that an error had been made — Edmonton was *not* on the ocean. Moving to Vancouver, British Columbia, he has lived beside the sea ever since.

He attended the University of British Columbia, taking an Honors degree in Zoology in 1938. Two years later he received his M.A. degree in Zoology, as well as completing the Education course. The latter he regarded as a mixed blessing since it led to a high school job, teaching mathematics instead of biology. After one year of this, at Coquitlam, B.C., a philanthropic father-in-law supplied the capital necessary for Ph.D., work at the University of Washington. (The fact that the said father-in-law was also the high school's inspector, and had very high standards for the teachers at the school, he regards as irrelevant.)

As an undergraduate he worked during the summers for the Fisheries Research Board of Canada. So, when he entered the School of Fisheries at the University of Washington, he was able to induce the Director of the International Pacific Salmon Commission to give him a part-time job. This developed later into a permanent position on the Commission's staff.

After some 7½ years with the Commission, working on the sockeye salmon problem of the Fraser River, Dr. Idyll joined the staff of The Marine Laboratory of the University of Miami in 1948, to take charge of the fishery research and to teach fishery biology. In 1955 he became Chairman of the Department of Marine Sciences. He is also Executive Secretary of the Gulf and Caribbean Fisheries Institute.

In 1941 he married Marion Daniels and they now have three charming and pretty daughters.

Dr. Idyll is frequently asked how he happened to move so far across the country, from the extreme northwest to the extreme southeast. Many reasons could be cited, he declares, but the simplest is annual rainfall averages for Seattle versus hours of sunshine for Miami.

DR. JOHN E. RANDALL

As a displaced Californian, Dr. Randall is something of a rarity in Florida. His university studies, begun in 1942, were interrupted by service as an officer in the Medical Administrative Corps of the U. S. Army. In 1950 he received his B.A. in zoology at U.C.L.A., along with election to Phi Beta Kappa. The same year he sailed a 37-foot ketch, which he had built from the hull, to Honolulu, where a position as graduate assistant in the Department of Zoology of the University of Hawaii awaited him.

In Hawaii he joined an expedition to the Gilbert Islands, as ichthyologist, and, with the aid of a fellowship from the Office of Naval Research, wrote a book on the fishes of that remote mid-Pacific archipelago.

Following his Ph.D. in marine zoology in 1955, he sailed for Tahiti in his ketch with his Chinese-Hawaiian wife (who has a master's degree in zoology), and three-year-old daughter. In Tahiti he studied, under the sponsorship of Yale University and the Bishop Museum, the biology of a grouper being considered for introduction into Hawaiian waters.

Since September, 1957, Dr. Randall has been a member of the staff of the Marine Laboratory, University of Miami, where he holds the Robert E. Maytag Chair of Ichthyology. He will soon embark on a biological study of the coral reef fishes of Florida.

DR. CARLETON RAY

In 1954, as a member of the Juneau Ice Field Research Project, Dr. Ray achieved dubious notoriety as the discoverer of the North American snow flea. Less publicized were important data he assembled on life on glaciers and their surroundings, obtained during a three months sojourn on a glacier. Recently his interests have centered on life underseas, including field work in both tropic and temperate waters. He is coauthor, with E. T. Ciampi, of *The Underwater Guide to Marine Life*. At present he is a member of the staff of the New York Aquarium, serving as assistant to the Director, Mr. C. W. Coates. The New York Zoological Society, of which the Aquarium is a part, is conducting a number of studies of wildlife conservation in order to increase public awareness of the challenge of increasing population and vanishing resources.

Aircraft Adopt Ships' Lighting

FOLLOWING THE CUSTOM of ships at sea, every aircraft now carries a red light on the left (port) wing tip and a green light on the right (starboard) wing tip. On the tail, a red and white are shown. The red light is in addition to the customary white stern light of ships.

Where Do Sea Bubbles Come From?

ON A sea voyage, have you ever wondered why the surface of the ocean, even on a calm day, is sometimes nearly covered with bubbles? Because bubbles are of interest to both marine biologists and underwater sound specialists, a Navy scientist has made a study of them, not only at the surface but also below.

Here is what Dr. E. C. LaFond, of the U.S. Naval Electronics Laboratory, Point Loma, California, and a member of the International Oceanographic Foundation has learned: Some bubbles are formed from sea floor gas seepage, some from the decomposition of organic matter. Others result from wind action and breaking waves, but these do not extend below 20 feet.

Some bubbles also are formed, for reasons not clearly understood, beneath sea surface slicks. Others come from the generation of oxygen by plankton. Finally, but not to be overlooked, are "burps" from fish.

Progress

IN THE SHORT PERIOD of its life, *Sea Frontiers* has now reached a circulation of 15,000, not all of whom are members. They are drawn from the United States, Canada, Central and South America, Great Britain, Australia, France, Germany, Italy, Denmark, Sweden and Norway, as well as a few from the Pacific Islands and the West Indies. Continued improvement will be possible with growth of active membership. It will be seen in better service, with more articles in the Bulletin of high interest and authenticity and, eventually, a monthly issue in full color.

Members are joined in these aims and they are urged to make progress possible by taking the small effort needed to enlist new members. To those who are not members, but whose interest and curiosity lie in the sea and the spirit of discovery, there is extended an invitation to participate by simply mailing a card. The ocean is our last frontier and its exploration still under way.

The editor will be glad to consider for publication articles and illustrations covering explorations, discoveries or advances in our knowledge of the marine sciences or describing the activities of oceanographic laboratories or expeditions in any part of the world.

The International Oceanographic Foundation

"To encourage the extension of human knowledge by scientific study and exploration of the oceans in all their aspects, including the study of game fishes, food fishes, ocean currents, the geology, chemistry, and physics of the sea and the sea floor."

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MEMBERSHIP

The Foundation was established by a group of saltwater anglers, yachtsmen, shipowners, marine scientists and others interested in the scientific exploration of our last frontier, the ocean. Its objectives are to provide support and encouragement for marine research, exploration and discovery and to promote the collection and dissemination of scientific knowledge about the ocean.

Qualifications for membership are an interest in the oceans and a desire to extend and develop scientific research and exploration into them. Support given to research through personal activities or donations is recognized by the Foundation through the following classes of membership. Members are those who make annual contributions of $5, Fellows $25 annually; Associates $100 annually; Life Fellows are those who contribute $200 or more or who have otherwise helped to advance the purposes of the Foundation; Sponsors who contribute $1,000 or more; and Patrons who contribute $5,000 or more.

According to a ruling of the U.S. Treasury Department, donations made to the Foundation are deductible in computing taxable income as provided for by the 1954 code.

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